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New Factory version has CAD look

LOGICAL FLOW/69

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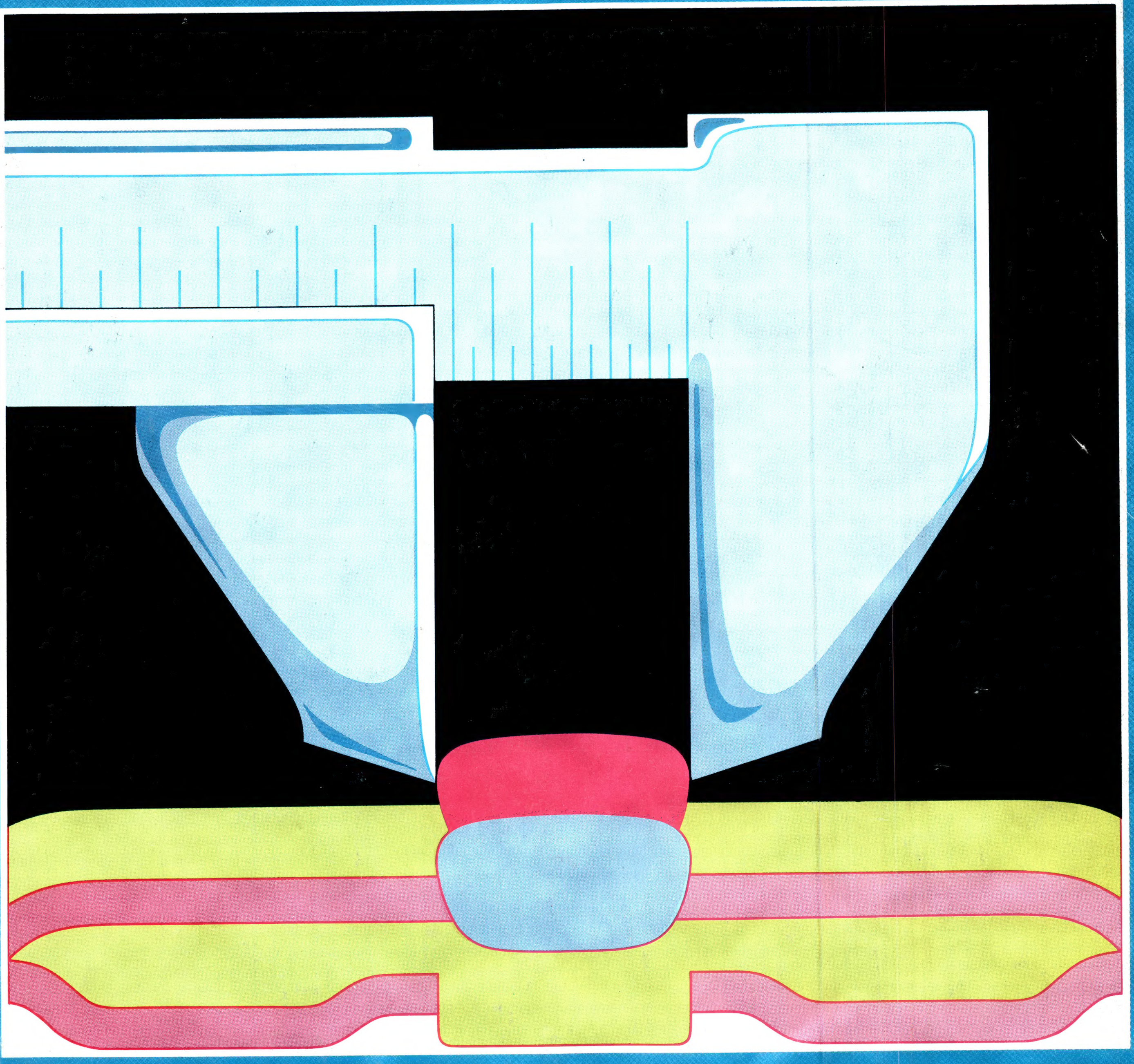

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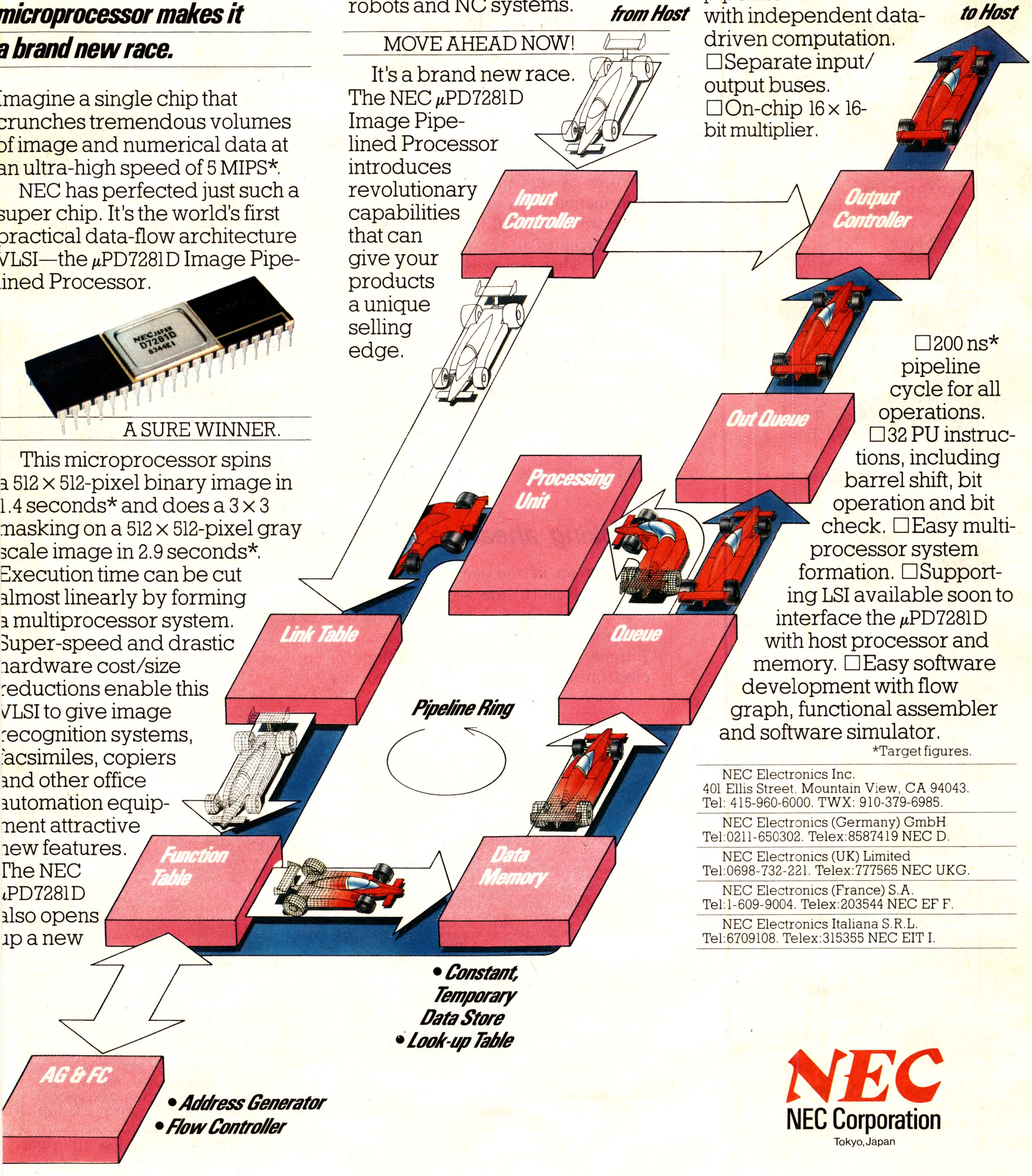

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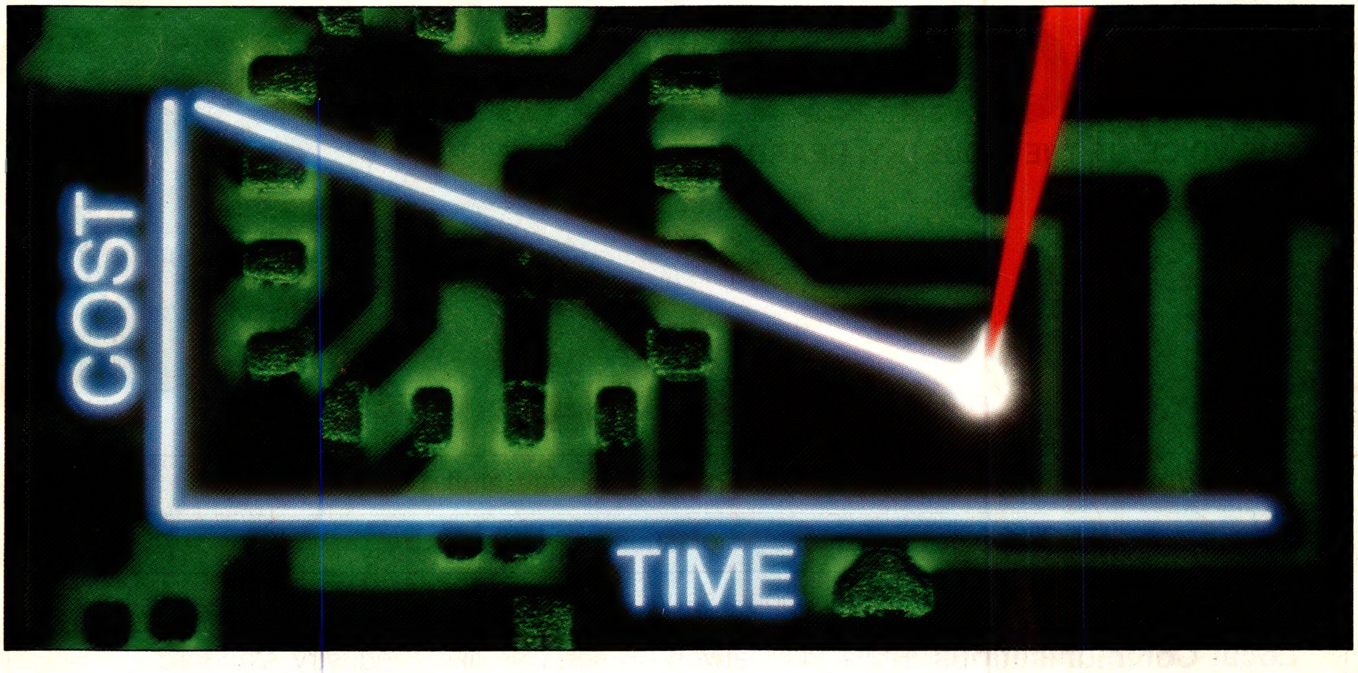

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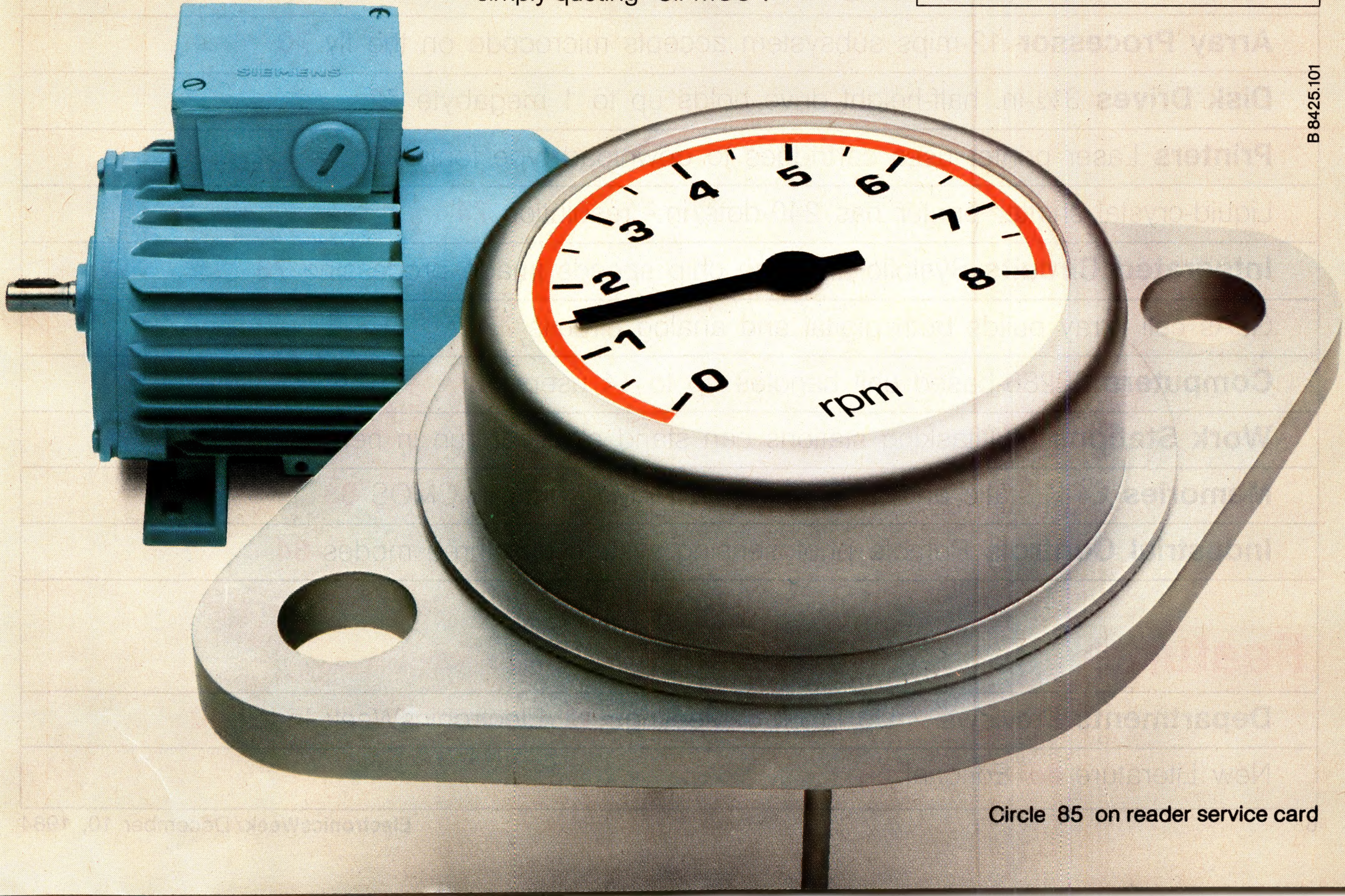

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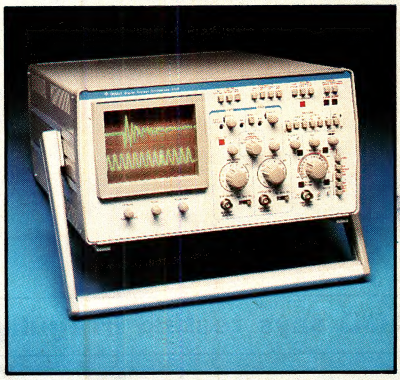

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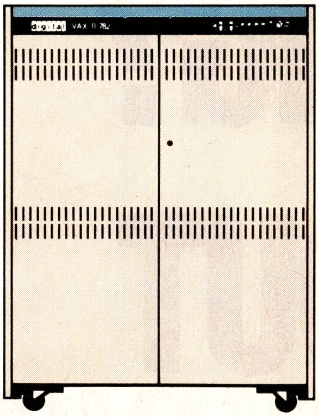

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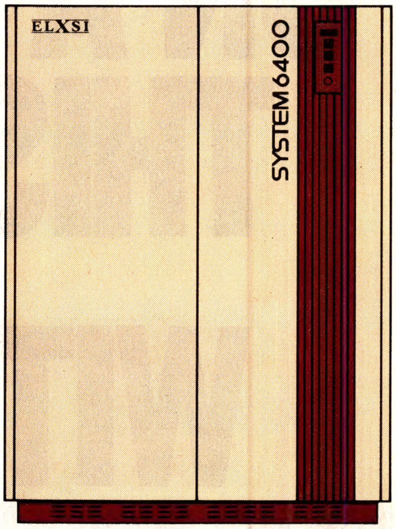

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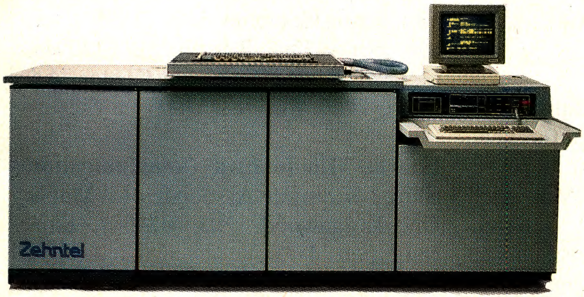

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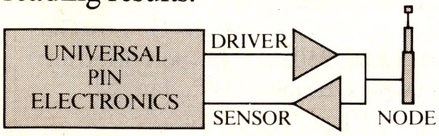

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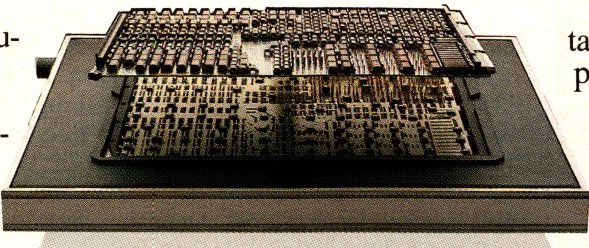

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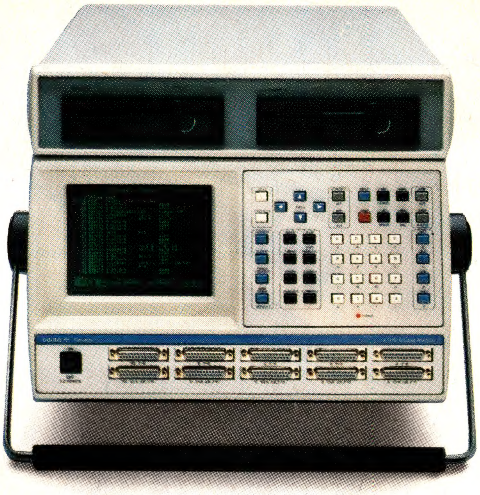

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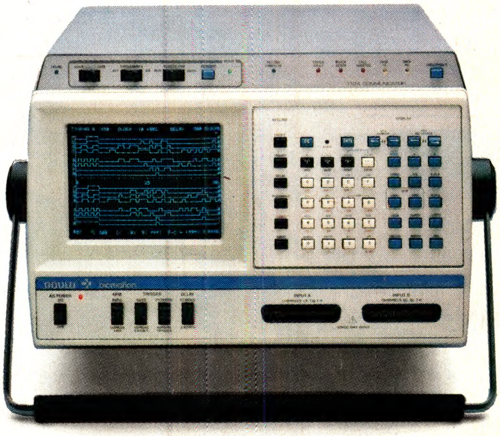

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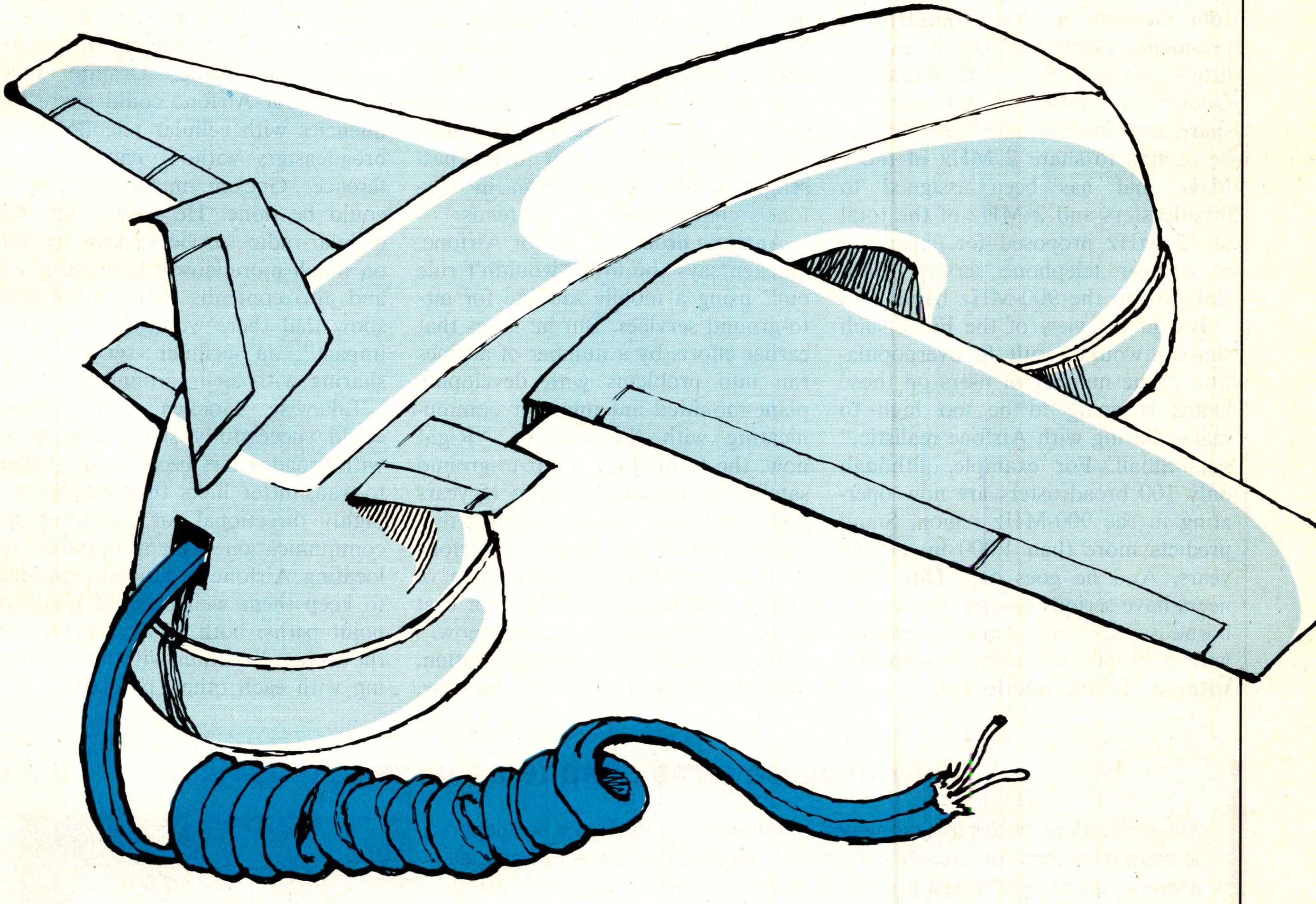

FCC deems pay phones in sky a luxury for a privileged few, and refuses frequency slot, but Airfone fights on

☐ *By Karen Berney and Wesley R. Iversen*

Washington

Airfone Inc., the company that wants to put pay phones on the nation's airliners, now must turn to advanced communications—shared satellite or terrestrial channels—to transform its current experimental setup into a permanent service.

The Oak Brook, Ill., firm has been operating an air-to-ground voice service since mid-October on 4 MHz of paired spectrum, 944 to 947 MHz and 899 to 901 MHz, under an experimental license. It currently has a total of 22 phone-equipped planes in the air spread across six commercial airlines. In late November, however, the Federal Communications Commission announced its finding that the service "is in the nature of a luxury," likely to be used by only a miniscule proportion of the flying public. Although the FCC extended Airfone's license to Dec. 1, 1985, the commission at the same time decided to allocate the frequencies to two other groups—TV broadcasters and private land-mobile users [*ElectronicsWeek,* Dec. 3, 1984, p. 8].

Nonetheless, Airfone does have a reasonable chance of winning FCC

SCIENCE/SCOPE

Radar and sonar video signals can now be displayed without fading, thanks to a newly developed video image processor. The device converts analog images into digital format so those images can be stored and displayed continuously on a standard television monitor. In addition, images can be shown on remote monitors and be recorded on videotape. The Hughes Aircraft Company processor, using digital storage, offers greater versatility and a wider range of information than analog circuitry. Digital storage allows considerably more flexibility in retaining and updating tight images than previously available using analog circuitry. The processed digital image resembles a conventional TV picture and can be seen in ambient light, eliminating the need for a darkened room.

Weather satellites help airlines save $700 million in fuel bills, thanks to timely pictures and other data. Meteorologists who plan trips for airlines use satellite information to find efficient travel routes. For example, normally the route between Los Angeles and Hawaii is about 2,300 miles. In case of a headwind, the airline will select an alternate route. Even though the new route may be 2,500 miles long, better flying conditions could save the airline $1,500 in fuel. The latest three spacecraft in the Geostationary Operational Environmental Satellite (GOES) system were built by Hughes. The sensing devices, which provide the daytime and nighttime pictures shown on TV and printed in newspapers, were built by a Hughes subsidiary, the Santa Barbara Research Center.

Thermoelectric cooling has made a hand-held infrared viewer more convenient and more economical. The Hughes Probeye™ infrared viewer, originally equipped with argon gas cooling, now comes in an all-electric model. The new version weighs 1.2 pounds less and makes sustained use easier and less tiring. The Probeye viewer sees heat the way a camera sees light, converting it instantly into an image seen through an eyepiece. The viewer is used to spot heat maintenance problems and energy losses in industrial and commercial applications.

The first attempt to sample the atmosphere of an outer planet, NASA's Project Galileo will journey 750 million miles to Jupiter this decade. The mission will consist of two spacecraft, an orbiter and a Hughes-built probe. Six instruments inside the probe's descent module will assess the structure and composition of the atmosphere, determine the location and structure of clouds, calibrate a precise ratio of hydrogen and helium, and measure lightning, radio emission, and energy absorption. The probe will transmit data to the orbiter for relay to Earth. Project Galileo will be the first interplanetary vehicle launched from the space shuttle. The launch is set for May 1986 and arrival for August 1988. Four Hughes-built probes explored the atmosphere of Venus in 1978.

Hughes needs engineers, scientists, and programmers to design and build advanced airborne and spaceborne radar systems, including data links, electronic warfare systems, and display systems. We need systems analysts (communications and control theory, signal processing, applied mathematics), microwave specialists (antenna, receivers, transmitters, data processors), circuit designers (analog, digital, RF/IF), scientific programmers, mechanical designers, and systems and test engineers. Send your resume to Engineering Employment, Dept. S3, Hughes Radar Systems Group, P.O. Box 92426, Los Angeles, CA 90009. Equal opportunity employer. U.S. citizenship required.

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HUGHES
AIRCRAFT COMPANY

figure represents 748,000 devices networked together, Snell says.

"There are a tremendous number of personal computers out there," observes Micheal Killen, president of Strategic Inc., a Cupertino, Calif., market research firm. "Everybody who wants to interface with, and be part of, the IBM world will have to develop products" to connect with PC Network.

Big Blue approves. "IBM has always wanted an open architecture [for the PC and now PC Network]," Sytek's Pinsky points out, adding that IBM supports the decision. A spokesman for IBM's Entry Systems Division in Boca Raton, Fla., which is responsible for the PC and PC Network, agrees with Pinsky's statement. "We've said all along that the Sytek protocols would be available to designers to license. This [the Sytek decision] is nothing we didn't expect," the spokesman said.

The very fact that IBM is pursuing an open architecture with the network—just as it pursued an open architecture with the PC—is the main reason market watchers expect IBM to dominate the LAN market for personal computers. George F. Colony, president of Forrester Research Inc., an office automation research firm in Cambridge, Mass., thinks the PC Network "will dominate the market" even though it's "not a terrific system." The researcher says IBM will now offer "the standard work station supported by the standard network": the PC on PC Network. "That's very potent, very tough competition," he notes.

As Colony sees it, PC Network will enable applications developers to create applications software that interfaces with the network. "Within 9 to 12 months, we'll see independent software vendors offering new kinds of distributed software using the network," he says. In addition, Colony believes major third-party vendors—such as DEC, Data General, Wang, and "a number of other personal computer vendors"—will support the network.

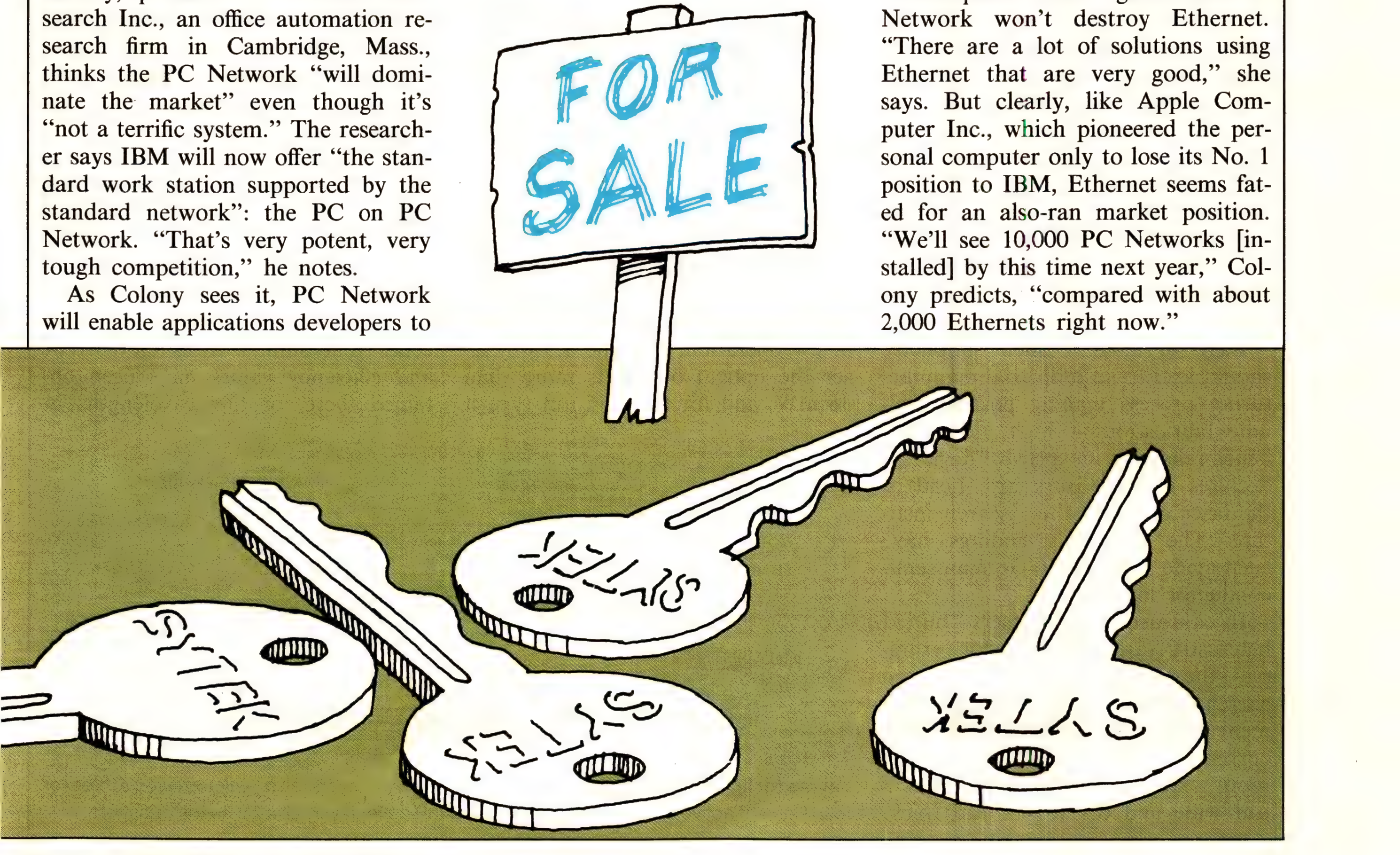
All of this could spell trouble for some vendors of alternative LAN technologies and products. The main LAN now in the market is Ethernet, a 10-Mb/s baseband (versus the broadband PC Network) local network developed and pioneered by Xerox Corp., Stamford, Conn., in conjunction with Digital Equipment Corp. and Intel Corp. The main battle that Ethernet and other LANs will have to fight with PC Network is the fact that PC Network comes from IBM.

Users "are paying more attention now than six to eight months ago to whether systems conform to a standard or not," says Dataquest's Snell. While PC Network is not an industry standard, as is Ethernet, which has been approved by a committee of the Institute of Electrical and Electronics Engineers, "because it's from IBM, that makes it a standard," Dataquest's Snell believes. "A lot of LAN companies will license the protocols from Sytek, not because Sytek is a strong, viable company, but because [the protocols are used by] IBM," she says.

PC Network, one market analyst says anonymously, "fuels the momentum for an IBM approach [to LANs]. Opening up the architecture encourages all other vendors to conform to the overall standard of the IBM world." This will enable IBM to further control the direction of the office automation market, this analyst believes.

Other nets. This doesn't necessarily mean that other networks, such as Ethernet, will disappear. A Xerox spokesman says Ethernet is now a worldwide standard that "can't be changed at the whim of a manufacturer." There are now more than 200 firms making Ethernet-compatible products, as well as six to eight firms other than Xerox selling Ethernet systems, he says. "It is a mature product line with an installed base."

Dataquest's Snell agrees that PC Network won't destroy Ethernet. "There are a lot of solutions using Ethernet that are very good," she says. But clearly, like Apple Computer Inc., which pioneered the personal computer only to lose its No. 1 position to IBM, Ethernet seems fated for an also-ran market position. "We'll see 10,000 PC Networks [installed] by this time next year," Colony predicts, "compared with about 2,000 Ethernets right now."



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Circle 87 on reader service card

question. However, the lasers involved are more complex. The U.S.-made types, for example, exploit mass-transport reactions, a difficult process to control. What's more, part of the current can bypass the active layer, which negatively affects the linearity of the characteristic curves.

In making its mushroom lasers, the German researchers use liquid-phase epitaxy on p-InP substrate to grow a buffer layer, also of p-type InP material. Then comes the n-type active layer of either InGaAsP or InGaAs (for wavelengths of 1.67 μm). Atop the active layer comes a 2-μm n-type InP confinement layer.

Making mushrooms. For fabricating the laser structure, silicon nitride strips are employed as masks in ordinary photolithographic lift-off techniques. The mushroom structure is obtained in a two-step chemical etching process. In the first step, the top InP layer is etched to produce the mesa on the active layer. After that, the active layer is removed from the free surface and the mesa is underetched to the desired extent. By precisely controlling underetching, it is possible to reproducibly etch active stripes with good homogeneity of less than 1 μm.

After removing the silicon nitride strips on top of the mesa, the entire device is covered with a silicon dioxide film. This film, which is between 0.1 and 0.5 μm thick, passivates the active layer; this protects it against contamination. The oxide film also forms supports from the edges of the mushroom to the buffer layer, improving the mushroom's mechanical strength.

The silicon dioxide on top of the mesa is then removed, and ohmic contacts are formed by evaporating suitable metallic substances onto the indium phosphide surfaces. The laser chips are soldered to copper heatsinks either upside down or upside up. Finally, gold wires are soldered to the device.

Fast blinking. The mushroom lasers can be modulated with digital signals of more than 1 Gb/s. In a transmission experiment carried out with a laser emitting light at 1.3 μm and modulated with 284-Mb/s signals, the error rate of received signals on the 36-mile monomode-fiber link turned out to be less than one error in 1 billion. **–John Gosch**

PC COMMUNICATIONS

PROTOCOL-STANDARDS FIGHT WILL BE WON IN THE MARKET

New York—Three contenders are left in the battle to become the standard communications protocol with which to link personal computers having dissimilar operating systems. Promoters of two of those competing systems agree the market will ultimately decide which one wins.

"You have to look at the *de facto* standards arena for a solution," says Gregory Pearson of Microcom Inc., Norwood, Mass., chief architect for the firm's Microcom Networking Protocol (MNP). Pearson, who spoke last week at a conference on microcomputer-communication standards, says such a standard will be the result of an ad hoc consensus.

Robert Fultz, product manager of personal computer applications at Tymnet Inc., San Jose, Calif., says his firm hopes to make its protocol, X.PC, the *de facto* standard "based on the number of vendors supporting it within their applications." Nevertheless, a report by conference sponsor Link Resources of New York, a subsidiary of International Data Corp., warns that "implementation of any one of these protocols involves considerable expense and risk if the protocol implemented does not become standard."

Different mode. Unlike the other two protocols, the third contender, the International Telegraph and Telephone Consultative Committee's (CCITT) X.32 protocol, is the only one in a synchronous transmission mode. This may give X.32 a leg up on the competition, says a study by Link, because all standards bodies are focusing on synchronous protocols. CCITT's X.32 will be publicly announced next spring.

While Microcom's MNP stresses error detection and correction, the Tymnet X.PC, available since September 1983, is geared to providing value-added-network services to personal computer users. Based on the X.25 protocol, X.PC provides customers with a local connection to a packet network as a network communications standard rather than a host communications standard. Because it is based on International Organization for Standardization (ISO) and CCITT protocols, X.PC is a standard already, asserts Fultz.

Other needs. Fultz believes microcomputer requirements over the next two years will include an error-free transmission capability, an increase in speed to 2,400 b/s, enhanced log-on procedures, and universal connections, among others. Current network concepts are essentially the same, he argues. Only their implementations will differ.

Pearson says MNP allows several possible architectures, including byte-level error detection and correction on modems or within software. MNP currently addresses the data-link, session, presentation, and application layers of the ISO's seven-layer Open Systems Interconnection model. It has been publicly available since July 1983 with a one-time license fee of $2,500, and Microcom has about 70 licensees, he adds.

"MNP is a more comprehensive product," says Mark Winther, Link's director of new communications services. "X.PC is more specialized." Although he leans toward Microcom's protocol as a standard, Winther says the modem manufacturer may have a difficult time persuading other modem companies to use MNP. **–George Leopold**

U. S. LOCAL LOOP DATA-COMMUNICATIONS MARKET FORECAST (MILLIONS OF DOLLARS)

Transmission rate	1983	1984	1985	1986	1987	1988	1989
Less than 56 kb/s	453.2	554.5	678.7	769.4	960.0	1,150.0	1,360.0
More than 56 kb/s	61.8	121.5	226.3	361.6	640.0	799.5	943.0

SOURCE: LINK RESOURCES

Wire-Wrap can't be used with High Speed Logic ... and Bumblebees can't fly!

An aeronautical engineer once "proved" that bumblebees can't fly, because they couldn't possibly move their wings fast enough. And a lot of people still believe that.

But Bumblebees can fly.

Some electronic engineers believe that Wire-Wrap can't be used with high-speed logic, down to the sub nanosecond range.

But Augat's been doing it for years.

So you can have high-speed logic, plus all the advantages of Wire-Wrap: faster time to market, design flexibility, better thermal management, component pluggability, and the lowest possible development costs. Along with the kind of engineering support you would expect from the market leader.

VAX-BASED WIRING SOFTWARE MAKES IT FLY

The key to making high-speed logic perform in Wire-Wrap is Augat's VAX-based wiring software.

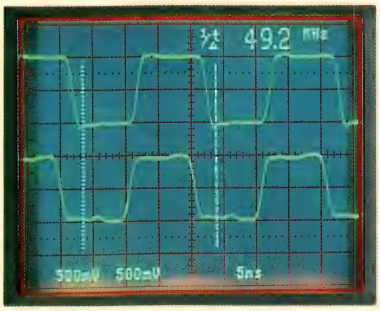
You might expect problems with crosstalk, uncontrolled high impedance, and propagation delays.

But, in fact, crosstalk can be minimized through the selective use of twisted pair wiring, and transmission line reflections can be nearly eliminated by the proper wiring of terminating resistors. Orthogonal wiring is always routed to minimize line length, and even point-to-point wiring is automated.

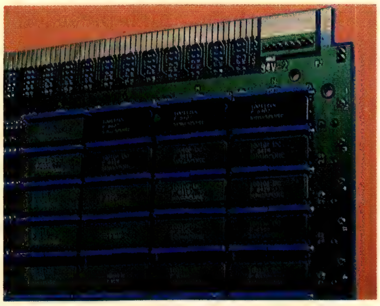
Once the VAX is done routing and analyzing your circuit requirements, a machine-readable set of documentation is provided to you to assist you in debugging the board and back-annotating your CAE database.

WIRE-WRAP BRINGS YOU A BEEHIVE OF BENEFITS

Wire-Wrap offers numerous advantages in developing and producing high-speed logic boards.



This unretouched photo shows a .8 nsec rise time pulse at the entry point (top wave form) and at the end (bottom wave form) of a 21" Wire-Wrap transmission line. By using twisted pair and properly terminating the line, ringing and reflections are minimal.



F100K ECL devices and terminating resistors on a Wire-Wrap panel.

The inherently low capacitance of a Wire-Wrap transmission line increases signal velocity. Circuit changes are easy to make, without incurring sudden, unexpected costs or delays.

Wire-Wrap boards run much cooler than multilayer, because the pins act as radiators. One test showed that the ambient temperature for a large Wire-Wrap board was a full 7 degrees C. cooler than the same circuit in multilayer. That means increased component life and product reliability.

Pluggability makes it easy to replace parts when they fail or upgrade with new components when they become available. Or to work around component scarcity, building boards in advance and plugging in components as they arrive.

Wiring information can easily be extracted from your CAE workstation, so you can transmit the data to one of the Augat wiring facilities and have fully wired and documented panels sent back to you in days, not weeks.

AND THE SWEETEST PART OF ALL — YOU GET TO MARKET FASTER

Augat has all the design and engineering tools in place to support you when you need it the most. And the largest inventory in the industry of standard Schottky, 10K ECL, and F100K panels — all available from a nationwide network of distributors.

So, before you design that next generation high-speed board, you should have Augat's Wire-Wrap Flight Manual.

Because, after all, bumblebees *can* fly.

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Circle 27 on reader service card

VIDEOTEXT

INTERACTIVE SYSTEM TAKES COMMAND IN JAPAN

Tokyo—Videotext in Japan started on Nov. 30 with a gigantic traffic jam. Too many of the 1,800 charter subscribers in the Tokyo and Osaka areas, the only places where it is initially being offered, tried to access the new service through the 300 trunks provided.

This was probably a one-time problem, though, and system operators must now strive for more subscribers as well as getting present subscribers to use the system more. Goals for the future include 10,000 customers by the end of March 1985 and availability in all major cities within three years.

The interactive information system, developed by Nippon Telegraph and Telephone Public Corp. here, is known by the English acronym Captain, for character and pattern telephone access information network. It is designed to provide subscriber-selected graphic and textual information to residential and business customers over the switched telephone network.

New breed. Captain differs from other videotext systems in that it transmits information using a hybrid method—a combination of codes and patterns—rather than just codes. A pattern method was used in initial experiments, but the 10 seconds required to send each screen at the transmission rate of 4,800 b/s was considered excessive.

Coding permits 1-s transmission of a screen composed of the usual characters used in standard Japanese, as well as alphanumerics and Roman characters. The hybrid scheme also permits graphics and unusual Chinese characters to be implemented, but at the expense of a somewhat longer transmission time.

TV sets prevail. Initially, most subscribers will receive Captain on home TV sets through an adapter and an optional printer, although adapters for personal computers are also offered. Further off in the future, manufacturers may introduce TV sets with the adapters (and even MSX computers) built in. Availability of the low-cost hardware needed to fuel mass sales depends on the appeal of information from program originators.

Captain is set up to provide subscribers with five classes of service. The simplest service, rank one, supports only pattern transmission, with a translator in the Captain center changing all coded data to pattern data. The adapter is somewhat less expensive, but there is a wait of 8 to 10 seconds for each screen, to which most participants in an earlier test run voiced strong objections.

The higher ranks support the hybrid transmission method. Ranks above level two also allow the addition of geometric elements such as lines and arcs.

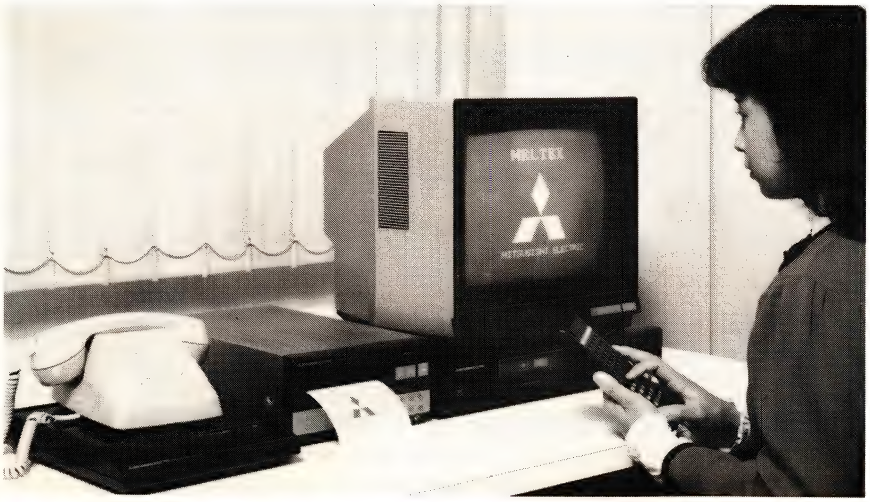
Rank two is expected to be the most popular service level among consumers, who will utilize its hybrid capabilities without having to pay for the ancillary services of the higher ranks.

Ten firms are now offering adapters for home TV, but the average list price is about $880—far too high for mass sales. Three companies hope to prime the market with rank-one adapters, but even they cost around $580. And while rank-one adapters may help start the market rolling, most observers predict that an eroding price differential as rank-two prices fall will contribute to the demise of rank one.

Although the schemes for transmission are radically different, the displays for broadcast teletext and videotext are similar. Broadcast engineers responsible for developing Japan's teletext believe it can be added at little extra cost to Captain-equipped TVs, although the reverse is not the case: Captain requires many capabilities beyond those required for the reception of teletext.

Closed user groups. Tariffs paid as part of a telephone bill make a closed-user-group provision in Captain's services a boon for large firms, which will be able to communicate nationwide at a low rate. At first, the groups will probably be most useful for information broadcasts from the information center. Later on, mailbox capability is contemplated, and there is also provision for commercial closed user groups that will only provide information to subscribers who sign on with passwords.

Japanese sources reckon that there are close to 500 potential information providers, including eight closed user groups. Home banking is one likely use, while other services include shopping and hotel and airline reservations. There is even videotext for interactive fortune telling and psychology. **–Charles L. Cohen**



First screening. Higher levels of the new Japanese videotext standard permit transmission of the detailed graphics essential for use with Japanese characters.

Photographed at Gulfstream Aerospace, Savannah, GA.

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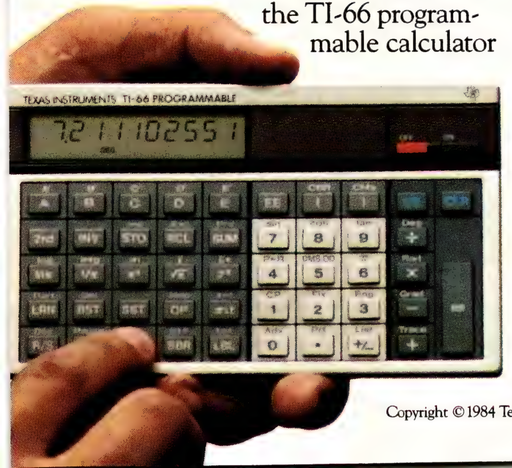

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Circle 33 on reader service card

using an unfamiliar technology came to harm because of avoidable errors.

"The most important part of a robot safety program is personnel training," said Carey Moore, safety director of GM's Oldsmobile Division, in Lansing, Mich. "Employees must be trained in theory where necessary and have hands-on experience. They must be made aware of the hazards of the robot and how to operate it correctly."

He pointed out, however, that workers shouldn't regard robots as threats to their safety. "The reason for a robot safety standard isn't because robots are more dangerous than other machines and equipment. In fact, occupational injuries and illnesses will be reduced through the use of robots. It can be clearly shown that over the past 30 years, the rate of occupational injuries has decreased as industrial automation has increased."

Man's responsibility. The actual precepts of the RIA standard are rather different from the Laws of Robotics first promulgated by science-fiction writer Isaac Asimov. Whereas Asimov sought to short-circuit any ill will toward human beings on the part of highly intelligent robots, R15.06 seeks, in effect, to do the opposite. Or at least to teach human workers to use their intelligence when dealing with their less intelligent robotic colleagues.

"The most important safeguard is common sense. Avoiding trapping-point situations and knowing where the emergency stops are located and when to use them are just a few examples of what people need to think about," says Peter Strubhar, development engineer at Caterpillar Tractor Corp., East Peoria, Ill.

Accordingly, R15.06 places the ultimate responsibility for safeguarding workers in the robotic environment with the employer, who must instill in his employees the necessary safety consciousness. "Such a task requires much more teamwork than other safety-related programs," points out Lloyd Carrico, director of technical services at the International Flexible Automation Center, in Indianapolis. "A single robot can be controlled from any number of sources, and anyone around it has to know what his fellow workers are doing."

Recognizing that both workers and managers must learn to treat robots as any other dangerous part of a complex operation, the new RIA standard draws on accepted standards for other industrial equipment. For example, the section concerning stored energy stipulates that every site of stored energy (such as capacitors, springs, and hydraulic pressure accumulators) be clearly labeled and that the robot have the means to release the energy when required.

In another example, the standard says that if two robots are controlled remotely from more than one location, each must automatically inhibit the other's operation if the action of one invades the other's work envelope.

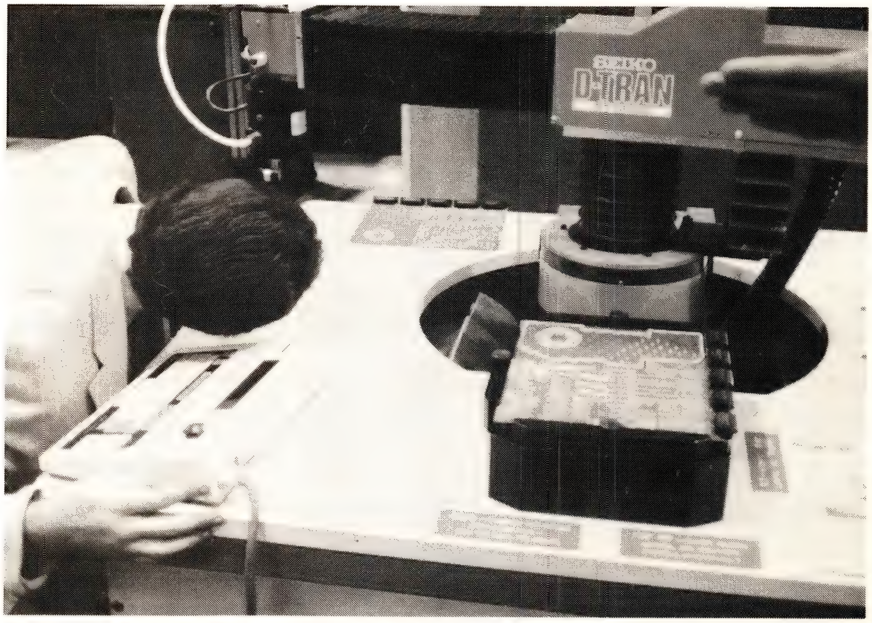
RIA stresses that the standard is for stationary industrial robots only and not intended to apply to personal robots, mobile robots, or automatic guided vehicles. The association also stresses that compliance with R15.06 is voluntary. Lauck believes that robot users will implement the training procedures that RIA recommends. But some responsibility may also need to fall on the robot makers.

Cincinnati Milacron's Robot Division, in Lebanon, Ohio, which manufactures robots for the extremely hazardous job of laser cutting, won't have to make "any major changes in terms of safety, since all our safety features are already in hardware—like EMR and EMI [electromagnetic radiation, and interference] shielding and easily accessible stop buttons," according to Dale Hendrixson, national sales manager. Where he does see room for improvement across the industry is in access control: keeping people out of a robot's operating envelope while the robot is working.

LED curtain. To that end, Dolan-Jenner Industries Inc., Woburn, Mass., has introduced its Safescan Perimeter Guard, which uses modulated light-emitting diodes to form an electronic curtain around the robot. (LEDs were chosen for the factory environment because of their resistance to vibration.) The robot can be programmed to shut itself off automatically if an unauthorized person or object breaks the LED beam.

Joseph P. Bellino, a systems engineer with General Electric's Robotics & Vision Division in Orlando, Fla., points out, however, that "preventing personnel from entering a robot's work envelope (or preventing projectiles from leaving) is not practical in all cases. A single technological solution is inadequate to ensure safety and an industry code must be mandated for the operation of a wide variety of robots," he says.

In one set of guidelines, for example, the RIA code requires all robots capable of hazardous motion to have "a maximum slow-speed setting of 10 in./s due to the action of any individual axis, and that the setting be maintained through any foreseeable malfunction."–**David M. Weber**



Watch your head. An operator watches intently as a robot assembles surface-mounted components nearby. New RIA safety standards warn against such close relationships.

NEW 'KEY' SYSTEM LOCKS OUT INTRUDERS

Palo Alto—Recent interest in computer security, heightened by both real and fictitious stories of system break-ins, has brought forth many proposals for controlling access to computer systems and protecting software from theft. Exotic security methods—retina-image scanning, fingerprint reading with laser beams, and various voiceprint and facial-image recognition systems—are being proposed, tried, and, in a few cases, actually used. However, these systems have one thing in common: their price tags are too high.

While such high-tech systems may play important roles in some large installations where the cost of security breaches would be very high or where very tight physical security is required, they don't offer useful solutions for companies that need to control access to corporate data systems, for example. Something more secure than fixed passwords is needed.

Low-cost system. A new Palo Alto company may be coming to the rescue with a low-cost computer access-key system for computer and software-access control that works and is simple to implement. The hand-held Access Keys—which are about the size of a domino—from Gordian Systems Inc. function very much like car or house keys. Users with the correct key can gain access to a computer system.

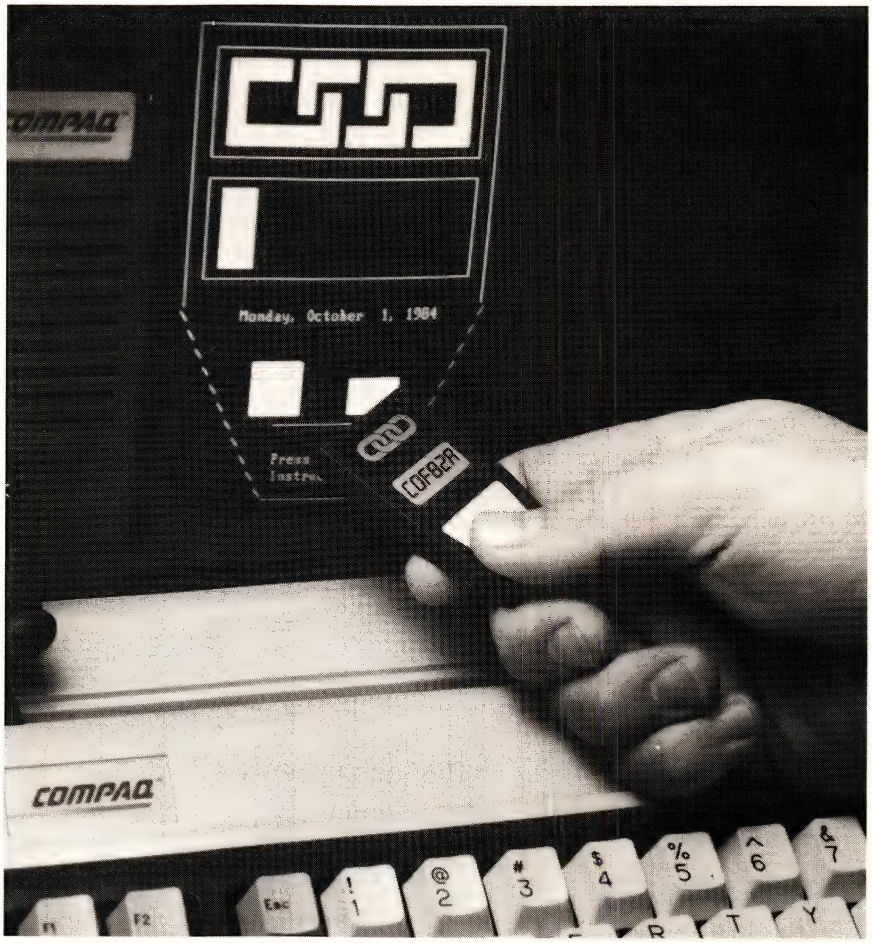
In the Gordian system, the host computer or specific application program generates a flashing random-number code—like a bar code—on the user's computer terminal screen (which can be a cathode-ray-tube or electroluminescent display, but not a liquid-crystal display as yet). The user holds the Access Key up to this area of the screen, and optical sensors in the key then read the number. A custom integrated circuit inside the key uses the random number and data resident in the key to produce a six-character password that is displayed on the key's LCD readout.

The user then types this password into the terminal or personal computer to gain access to the system. The data in the key ties the key to the individual who is authorized to use it for system or program access. Data in the key can be easily and quickly programmed or changed. A built-in real-time clock enables system operators to set access to the system for specified times and duration.

The difference between Gordian's approach and the easily defeated fixed-password schemes now in use is that the Gordian key generates a different password for each access. This defeats one common ploy: using a computer to search a list of passwords randomly until a valid one is discovered. Access Key passwords written down or transmitted over electronic billboards are useless. However, security does depend on the holder's retaining possession of the key. Presumably, any user of the key who is responsible for its use—and who has to answer or pay directly for it—will take as much care as with car and house keys.

Terminal independent. Any computer-security system that depends on a particular type of terminal or requires modification of existing terminals is likely to have limited application appeal because of the costs and the numerous difficulties involved in both modifying and replacing terminals. The Gordian Access Key has an advantage because it is inexpensive (Access Keys will cost as little as $10 in large original-equipment-manufacturer quantities), and it will work with essentially all types of terminals.

–Tom Manuel



Secure. An Access Key reads data from a signal sent by the host computer and, using a microprocessor, formulates the correct password for the user to enter in the terminal.

the current situation industrywide," states Gunther Rudenberg, a consultant for market researcher Arthur D. Little Inc., Cambridge, Mass. "When orders are received, semiconductor companies must try to ship them as fast as they can in order to get the business and take market share."

For the most part, chip markets are expected to get off to a slow start in 1985 while producers finish up clearing out the false orders from the books, says analyst Michael A. Gumport of Paine Webber Mitchell Hutchins Inc. in New York. "The personal computer shakeout is probably responsible for only 20% of the orders drop, which set in last summer," says Gumport. He estimates that chip customers double ordered on two months' worth of goods with no expectation of deliveries. "That adds up to about $2 billion. We have now between $500 million to $1 billion worth of backlog order to go before it's cleared out, which will be about Feburary," he says. Already, Gumport sees evidence of price stability settling into some markets.

The now-familiar story of too much optimism in personal computer markets continues to be retold by most top semiconductor executives in explaining what went wrong in 1984. "The personal computer market, like all newsworthy items, probably gets more publicity than it deserves. It represents less than 10% of the semiconductor usage," complains Charles E. Thompson, senior vice president and director of world marketing at Motorola Inc.'s Semiconductor Product Sector, Phoenix. "It is a pain in the neck for our industry because we are put in the role of trying to treat everyone fairly while not knowing who are going to be the winners."

Thompson maintains much of the reported weakness in chip business is simply on paper, with book-to-bill ratios just as artificially low as they were high earlier in the year. "The lead times went out from 10 to 20 weeks. Guess what? The customers have to place on order an additional 10 weeks' worth of products without their usage changing one bit," he notes. Thompson says the major question is the health of the world economy once the market overcomes its temporary paper crisis.

"I think the industry did a better job than in the past of realizing the book-to-bill would have to come down from 1.66 [in Dec. 1983] to below 1," says Michael Kubiak, the SIA's statistical programs manager. "What the industry missed was the magnitude of the inventory buildup. . . I don't think you'll see 1974 all over again, when the industry had massive layoffs. The economy is not expected to go down the drain in 1985. I'm not saying you won't have layoffs, but they won't be massive."

Revising forecasts. With figures compiled early this fall, the SIA—which for the first time this year has sales figures from Japanese producers—is projecting a 22% growth in worldwide chip volumes, reaching $32.2 billion. However, many members of the SIA forecasting task force are now greatly downsizing their own projections to less than 15% after continued weakness in October and November orders. In some cases, the dollar growth is expected to remain virtually flat in 1985, mostly because of heavy price cutting. Unit volumes are generally expected to rise some 10% to 20%.

In its Status 1985 report being released next month, Integrated Circuit Engineering Corp., Scottsdale, is projecting about a 20% growth in units, but dollar values are expected to climb only 12%. Sales of integrated circuits should reach $23.650 billion in 1985, compared to $21.165 billion this year. Discretes are projected to hit $6.25 billion, up from $5.8 billion in 1984.

William McClean, market researcher at ICE, estimates that prices even for leading-edge 256-K memories will drop sharply in 1985, falling under $10 in the year, compared to $20 to $25 a few months ago. For the moment, price levels are around $15. "That's a little steeper drop than the classical learning curve," he adds. **–J. Robert Lineback**

Newsbriefs

Bell Atlantic to offer local-net interconnection

Bell Atlantic plans to put a Local Area Data Transport (LADT) into operation in the nation's most densely populated region, northern New Jersey, during the first quarter of 1985. The move comes after the Federal Communications Commission ruled last month that the telecommunications firm may use its system to interconnect X.25 packet-switching networks and X.75 private networks. John Campanola, product manager for Bell Atlantic's Management Services Division, Arlington, Va., says the LADT routes data from asynchronous terminals over a packet-switched local network to central data bases, service providers, and other terminals, such as personal computers with access to the network. Data is transmitted at 56 kb/s in the X.25 protocol. Customers can dial up access to the network over standard telephone lines at speeds up to 1,200 b/s; direct access with a dedicated line to the central office is also possible. With a voice/data mutiplexer, users can get simultaneous voice and data services at speeds up to 9,600 b/s.

DEC expands baseband Ethernet to broadband environments

Digital Equipment Corp., one of the developers of the Ethernet local-network standard, has extended the baseband network to a broadband environment. DEC, in Maynard, Mass., has brought out a broadband Ethernet transceiver, which it calls Decom, that is fully compatible with its Ethernet hardware and software. DEC also unveiled a broadband Ethernet frequency translator, or DEFTR, to provide connection to broadband cabling. Both work with DEC's VAX, PDP-11, and Professional 300 computer systems. Decom (priced at S4,250) and DEFTR ($4,500) will be available in the spring.

British videotex software heads for Japan

The heavy traffic that marked the start of the Captain videotex service in Japan by Nippon Telegraph and Telephone Public Corp. (see story on p. 29) could augur well for Aregon Ltd., a London software house. Under a $3 million, three-year deal, Mitsubishi Corp., Tokyo, will distribute Aregon's videotex software in Japan and the Far East. The package, which supports European and U.S. videotex standards, will be modified to handle Japanese text also.

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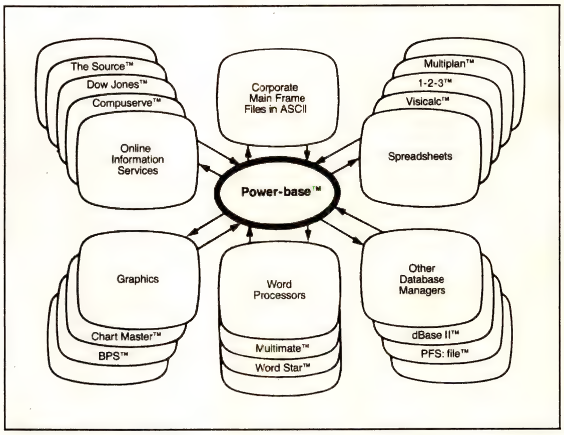

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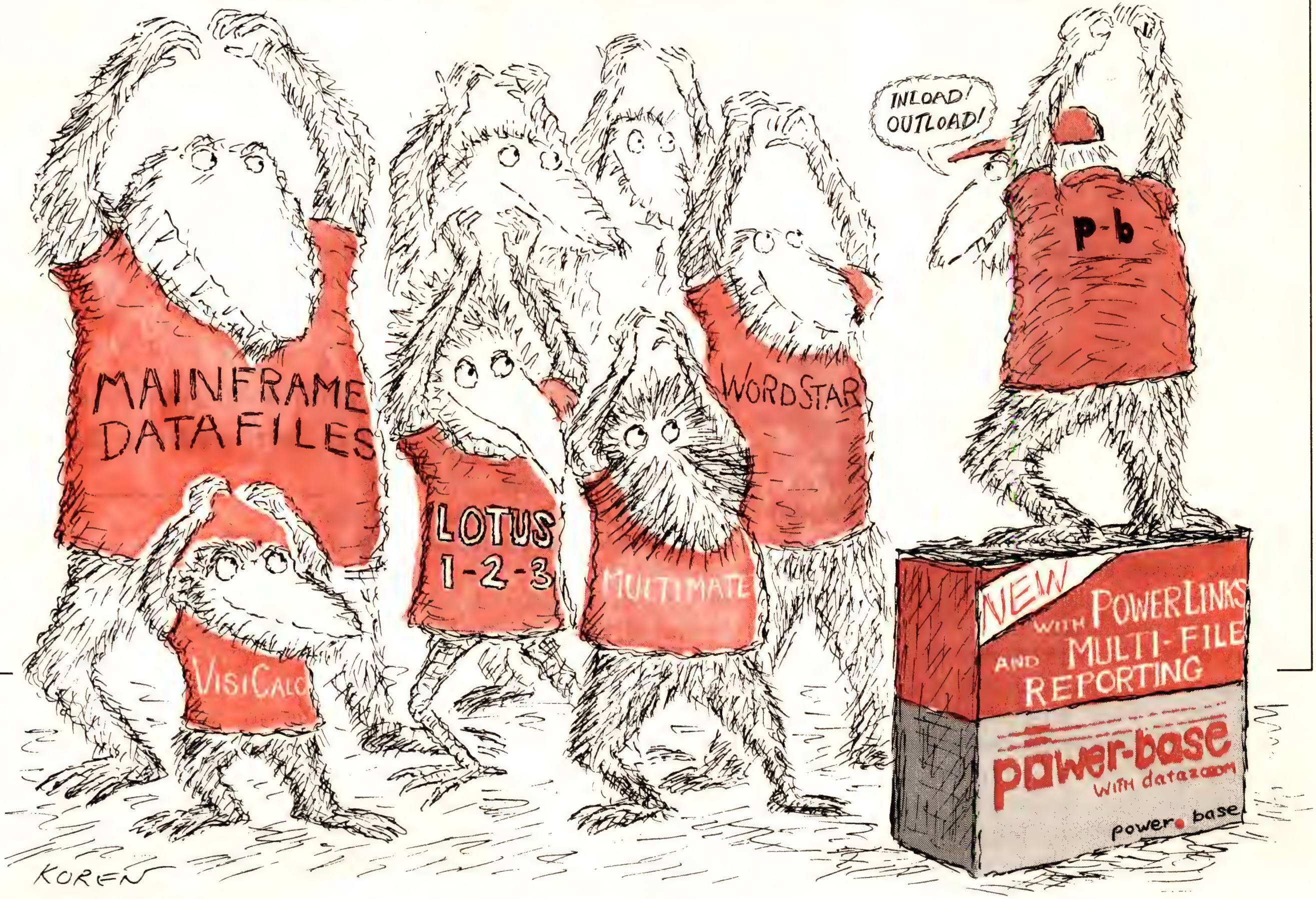

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Circle 41 on reader service card

CEIEC, the peripatetic Zhang travels widely in Europe and the U.S looking for deals that will promote active economic and technical cooperation and exchange, and boost China's import and export trade. Recently, he paid a fast visit to Electronica, seeking trade deals with European firms, and made a trip to Frankfurt, where CEIEC is opening a European headquarters. Later, he plans to visit Dallas, where CEIEC is planning to open a trade and technology center.

With headquarters in Beijing, CEIEC now maintains trade relations with more than 50 countries. Last year, CEIEC deals accounted for about $200 million in imports of equipment, components, and technology know-how, while arranging the export of $100 million worth of components, radio sets, and medical and production equipment.

Partnerships. To bring China's technology up to world standards, CEIEC has entered into more than 1,000 joint ventures. The PRC is particularly interested in computer and semiconductor manufacturing technology, says Zhang. In a typical joint venture, the CEIEC and a foreign partner each invest in it and share the profit in proportion to that investment.

Not typical, but widely publicized, was the pact with Hewlett-Packard Co., Palo Alto, in 1980, calling for joint sales and support of H-P computer and test-instrument equipment and, ultimately, the manufacture in China of selected H-P products.

The affable, 49-year-old Zhang assumed his post in 1980 after a career in engineering. After graduating from Ching Hua University (China's equivalent of Massachusetts Institute of Technology) in 1952, he joined a manufacturer of telecommunications gear and rose to chief engineer before joining CEIEC. **–Samuel Weber**

Emissary. Zhang Zhi Dong travels the U.S. and Europe looking for joint-venture deals to help boost China's foreign trade.

Single users owe a debt to David Nelson

Chelmsford, Mass.

Some say one's lifetime attitude toward computers is fixed by the earliest contact with the machines. Thus a generation first exposed to the massive and inaccessible time-shared units of the 1960s might be expected to resolve its frustration by inventing small desktop computers that are dedicated to a single user.

David L. Nelson, vice president of research and development for Apollo Computer Inc., is of that earlier computer generation and thinks there's something to that line of thought. He is also partly responsible for putting dedicated machines on thousands of desks around the world and will likely be responsible for thousands more.

New style. After receiving a PhD from the University of Maryland in 1970, the Minneapolis native worked on computer architectures at Digital Equipment Corp., Maynard, Mass. About this time the feeling arose within small-computer-design circles that time-sharing had seen its best days and would be replaced by a different computing style. That new style came to revolve around personal work stations and has been greatly influenced by the virtual-memory system developed by Nelson.

This system allows individual work stations to draw upon the resources of all disks in the network. "It's amazed me why people hadn't thought of that before," says Nelson. The working idea occurred to him after he left DEC and was at Prime Computer Inc., Natick, Mass., where he was research director and worked on a project to build diskless machines. But he traces the roots of the idea even farther back.

"I learned a lot from teaching and using Gordon Bell's textbook, *Computer Structures,*" says Nelson. "It raised an interesting notion of taking all the buses inside a computer and thinking of them in the same way, that is, a memory bus and input/output bus he called a switch.

"The real thing that led to virtual memory was recognizing that the network is just another variant of this general thing called a switch. So if we use an I/O bus to relate to disks, why can't we use a network to relate to disks? And out of that level of thinking, we sort of just came up with the idea of the network being essntially like a system bus."

When Nelson cofounded Apollo in 1980, execution of the idea was given the highest priority. The products developed blazed a trail in the professional-work-station market and made a fundamental change in computing style. "What we saw in 1980 was as significant as what we saw 15 years earlier with time-sharing," he says.

All major developments occurring now—such as artificial intelligence, computer-aided design and manufacturing, integrated systems—are subordinate to the concept of individual work stations, says Nelson, who keeps an array of computers at home and describes himself as a "real hacker." For now, he doesn't foresee anything of the magnitude of the work station development in the computing world. Having been in the forefront of one fundamental change, it's unlikely he'll be in the vanguard of a second, says Nelson. "But involved, yes." **–Craig D. Rose**

Milestone. Using a simple notion he read in a textbook, David L. Nelson developed the seminal virtual-memory system concept.

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TRACOR QUIETLY SUCCEEDS IN NEW MILITARY MARKETS

Austin, Texas

Unarmed duck hunters in ancient China and Austin's largest homegrown electronics firm have something in common. Both have enjoyed repeated success without making a big splash, suggests a whimsical Frank W. McBee Jr., chairman and cofounder of 29-year-old Tracor Corp.

That quiet approach to business is now speaking the loudest for Tracor in military markets for active countermeasures. In this growing business, Tracor has surprised leading defense contractors by snatching several key U.S. contracts. "It has been beating out firms like E-Systems and TRW by completely sneaking up on them," notes Mike Davis, vice president and industry analyst at Schneider, Bernet & Hickman Inc., a Dallas market research firm.

New generation. New computer-based countermeasures systems, such as these being assembled, are helping Tracor beat out its competition in the military market.

Tracor, which was spawned from the research laboratories of the University of Texas in the mid-1950s, is today an established leader in passive countermeasures for fighter aircraft and missiles. The firm's own systems are designed to confuse enemy radar by dispensing clouds of aluminum-coated glass fibers, known as chaff.

To divert heat-seeking missiles, these systems also release flares. Tracor's newest systems place chaff and flares under the control of a microprocessor-based computer, which automatically detects the type of threat.

But it is in the active-countermeasures arena, where signal-jamming electronics are used to deter threats, that Tracor has been scoring some impressive new military electronics wins. The most recent came in October: a $51 million three-year U.S. Army program, designated the Quick Fix IIB EH-60A Aircraft Countermeasures Integrated Systems project.

The contract was awarded by the Signal Warfare Laboratory of the Army's Electronics Research and Development Command in Vint Hill Farms Station, Warrenton, Va. It calls for Tracor to modify Black Hawk aircraft with electronic surveillance measures and active-countermeasures equipment.

At the same time, Tracor continues this year to score steady growth in all segments of its diverse product line, which ranges from complex airborne computers made with silicon-on-insulator chips, to analytical-instrument systems, to 35¢ fuses for refrigerators and automobiles. The firm, founded in 1955 as a research and development consulting group by four university professors and a lawyer, now has nearly 9,000 employees in 15 states and seven countries.

By the end of 1984, total sales should surpass the $500 million mark for the first time in its history. Just in the past year, Tracor became Austin's first local corporation to crack the Fortune 500 list. Despite the much celebrated electronics boom underway here, Tracor remains the city's only company listed on the New York Stock Exchange.

Attracts talent. McBee says Tracor is enjoying the ability to attract top engineering talent to the central Texas region with the new high-technology growth. Tracor has also added to its board B.R. Inman, the highly visible chairman of industry consortium Microelectronics and Computer Technology Corp., which is located across town.

McBee, the last of Tracor's founders still active in the firm, is not making long-range forecasts, but he is keeping the corporate sights on increasing revenues by an average of 15% and net income up by 23% over the next five years. After the third quarter, the firm's backlog orders stood at a company record of $345 million.

"We are interested in continuing emphasis on the areas we now understand," says McBee, suggesting that Tracor has no plans to spread itself into any new unrelated markets. "We will concentrate on the markets we already know, both in the manufacturing aspects and business. We are implementing new programs to bring new technology to our markets, however. [But] we are not big splashers, just quiet swimmers."

It is the kind of growth that market analysts have come to expect from Tracor in recent years, and the

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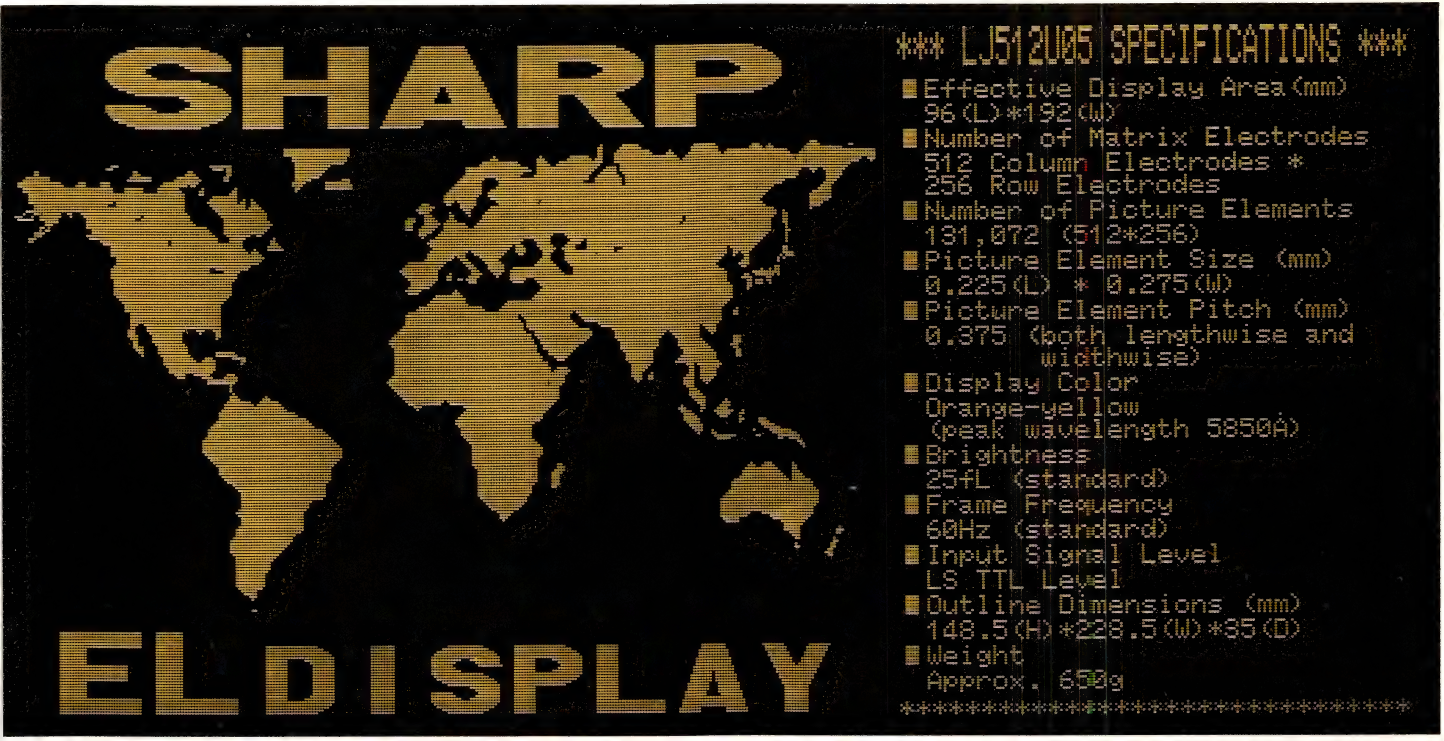

*** LJ512U05 SPECIFICATIONS ***

- Effective Display Area (mm)
  96 (L) *192 (W)
- Number of Matrix Electrodes
  512 Column Electrodes *
  256 Row Electrodes
- Number of Picture Elements
  131,072 (512*256)
- Picture Element Size (mm)
  0.225 (L) * 0.275 (W)
- Picture Element Pitch (mm)
  0.375 (both lengthwise and widthwise)
- Display Color
  Orange-yellow
  (peak wavelength 5850Å)
- Brightness
  25fL (standard)
- Frame Frequency
  60Hz (standard)
- Input Signal Level
  LS TTL Level
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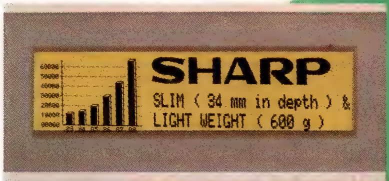

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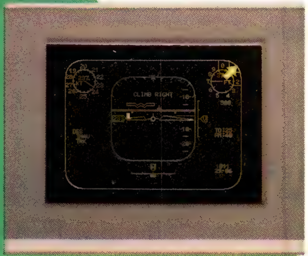

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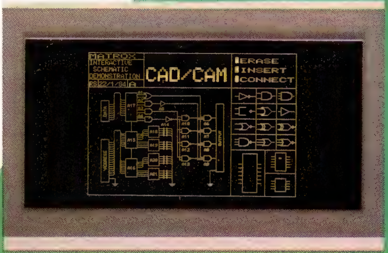

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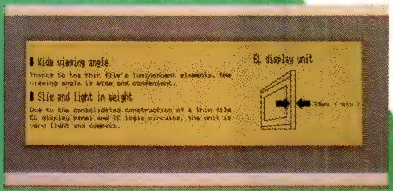

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ICs NUDGING THE SUBMICRON GEOMETRY LIMIT

IEDM hears about solutions to latchup problems, interconnection difficulties, and fabrication woes

☐ *by Eric J. Lerner*

For years, electronics theorists have assumed that the final limits to the size of electron devices will be found in the submicron region—that the shrinking of microcircuits will come to an end at line widths of perhaps 0.1 to 0.5 μm. For the first time, many device builders are reporting operating charge-coupled and MOS FET devices with submicron line widths. They are proposing new approaches to overcoming CMOS latchup problems, which worsen at submicron scales. To defeat interconnection difficulties, researchers are developing workable three-dimensional and stacked structures. They are taking on manufacturing barriers that stand in the way of multimillion transistor chips, a level of integration some are dubbing ULSI—for ultralarge-scale integrated circuits.

At the same time that the emphasis of the 30th Annual International Electron Devices Meeting at the San Francisco Hilton, Dec. 9-12, is on reducing chip size, other sessions at the IEDM tell of rapid advances in the field of sensors and high-frequency power devices. Integrated sensors are now moving into a wide variety of applications—a millimeter-wide complete pressure sensor and circuitry for medical implantations, toxic-vapor sensors, and sensor arrays for robotics.

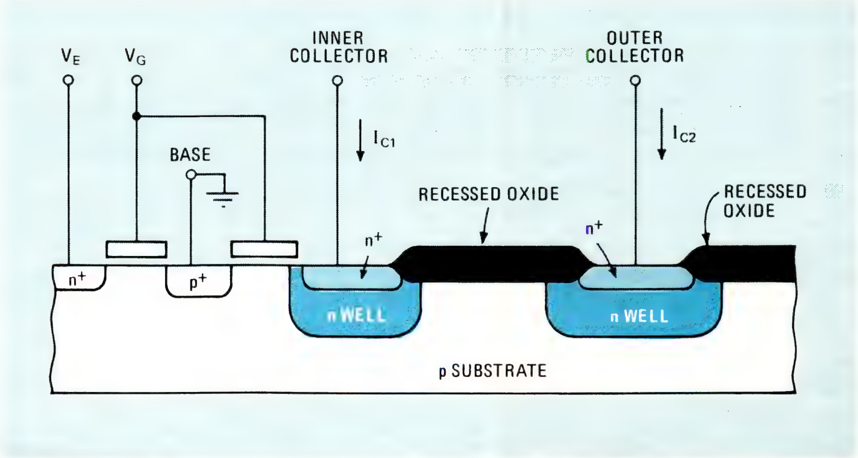
While sensors and chips are shrinking, power devices are growing and moving to higher frequencies—megawatt klystrons and 0.5-MW, 100-GHz gyrotrons for fusion research will be described. As power generation moves even deeper into the millimeter-wave region, gallium arsenide monolithic circuits are following for signal processing and other purposes.

At the start of the conference, G.H. Heilmeier of Texas Instruments Inc., Dallas, focuses on the key questions of the "limits to shrinking" in a plenary address, titled "Microelectronics: End of the Beginning or Beginning of the End?" Heilmeier warns both against complacency and against making the assumption that progress in ICs will continue along the same lines it has during the past 25 years.

Into the submicron region

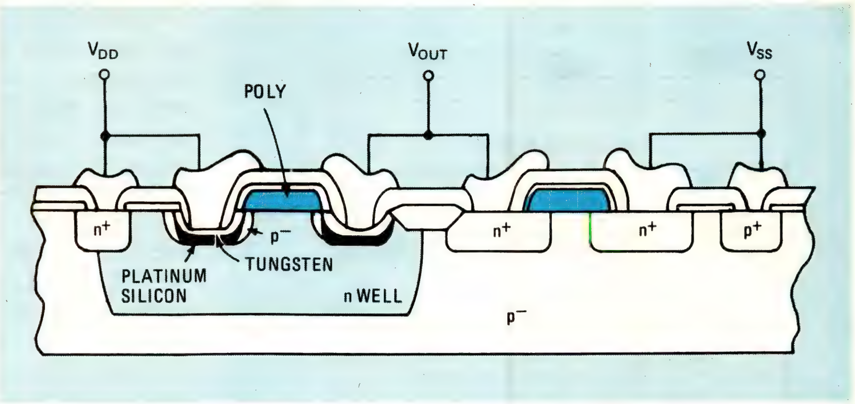
If no new structures are found, MOS and bipolar structures may reach their ultimate limits with geometries of between 0.3 and 0.5 μm. To go below this, new research, for which adequate funding is not now available, must be performed, he contends.

Yet the papers presented at the conference make it quite clear that not everyone is in agreement with him that the limits of existing device types are in view, or have been reached—in fact, some of the devices already built have line widths below a third of a micron. These include devices made by A.E. Schnitz and colleagues at Hughes Research Laboratories, Malibu, Calif., who have fabricated high performance p-MOS transistors with gate lengths as small as 0.3 μm. They have combined lightly doped drains, rapid thermal annealing, and self-aligned silicidation into a single process to produce these small-



1. Guard rings. One problem that occurs when CMOS is scaled down to submicron levels is that of latchup. This can be avoided by using n-well guard rings to isolate the two opposite-type transistors required for latchup to occur.

oxide film. Toshio Kobayashi at Nippon Telegraph & Telephone Public Corp., Kanagawa, Japan, was able to produce a 0.1-μm MOS FET using a 50-Å-thick gate oxide. The MOS FET had a high voltage-gain and high drain breakdown voltage—for example, a 0.2-μm MOS FET had a voltage gain of 27, while a 51-stage ring oscillator made with 0.3-μm MOS FETs had a stage delay of only 50 ps.



3. Dual approach. A combined attack on the latchup problem is launched by using both guard rings and Schottky barrier trenches. The Trenched Schottky Barrier p-MOS devices have contacts that are Schottky-like and simultaneously provide guard rings.

Taking a different tack for the smallest MOS FETs, H. Horie at Fujitsu Laboratories, Atsugi, Japan, has redesigned the devices using what he calls multiple self-aligned MOS technology, or MUSA/MOST. With MUSA/MOST, the sources and drains are formed by arsenic implantation in a molybdenum silicide layer, sandwiched between a trisilicon tetranitride underlayer and silicon dioxide overlayer. The technique achieves a shorter channel than conventional approaches, getting a 0.5-μm channel even though the smallest mask feature is 1.5 μm (Fig. 4). The MOS FET's active areas are reduced by 60%, and the parasitic capacitances are also cut in half.

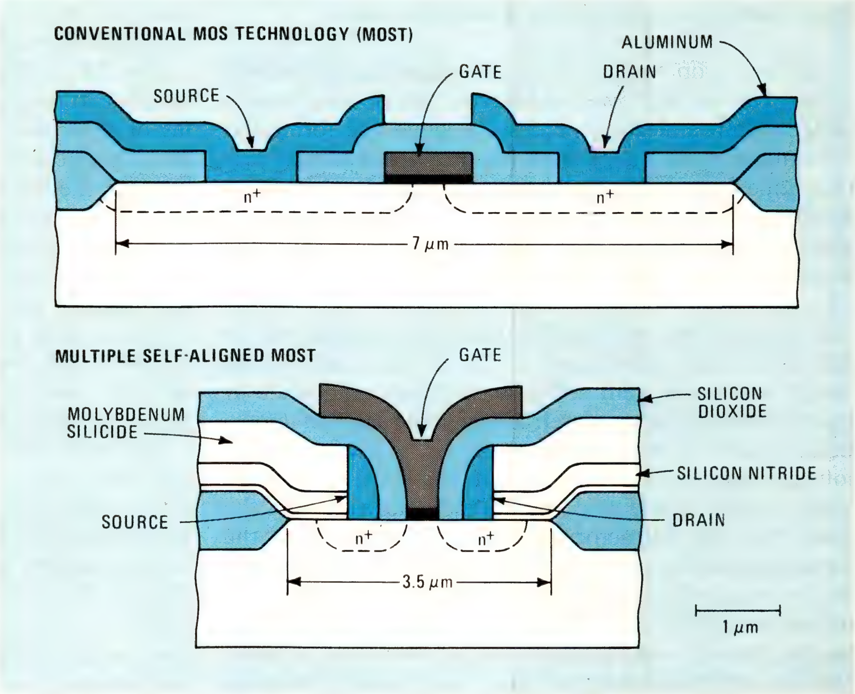
Although by far the center of attention is in downscaling MOS, and especially CMOS devices, a team of researchers at Philips Research Laboratories, Eindhoven, the Netherlands, has developed a submicron CCD memory structure for video memories and other serial data-storage applications. The 200-gate poly CCD shift register they fabricated has gates 0.6 μm in length with 0.4-μm gaps in between. Boron implantation is used as channel isolation, and the device, a surface CCD, has high stored-charge capability and steep potential wells—both properties critical for high bit density. The group is now fabricating serial-parallel-serial memory structures with 2- and 5-μm^2 cell sizes.

Getting submicron devices to work doesn't necessarily mean that very large-scale-integration chips can be made using them. As the number of transistors on a chip increases, the problem of interconnecting them worsens. The evening panel discussion on Dec. 11 points out some of the reasons. For one, the RC time constant associated with interconnection tends to increase or, at best, remain constant as scales decrease. Contact resistance gets worse, as does the yield and reliability of contacts—and electromigration becomes still more of a headache. Finally, the interconnections just take up too much room, necessitating a multilevel approach.

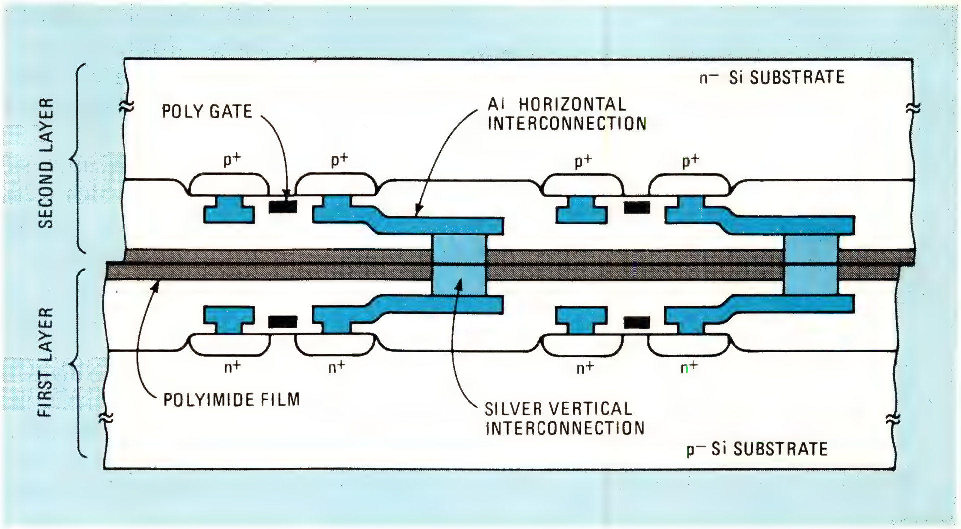
As interconnections get smaller, the materials used are clearly changing. As P.B. Ghate of Texas Instruments Inc., notes in his review of multilevel-interconnection technology, not only can't aluminum be used for submicron interconnections, but neither can poly. This leaves polycides or refractory materials. In some approaches, refractories used together with aluminum-copper alloys can greatly decrease electromigration problems.

Siliciding makes sense

To simultaneously reduce both contact resistance and diffusion sheet-resistance, C.Y. Ting of IBM's Watson Research Center points out that siliciding both the poly gate material and the single-crystal silicon diffusion region makes sense. Indeed, a Mitsubishi Electric Corp. team from Itami, Japan, led by K. Tsukamoto, reports at the conference that silicidation with titanium silicides does lead to a drastic reduction in resistivity: contact



4. Implants. Sources and drains of small MOS FETs are formed by implantation in a molybdenum silicon layer, in turn sandwiched between a silicon underlayer and a silicon dioxide overlayer. This creates a shorter channel than conventional approaches achieve.



6. Cliff dwellers. As devices get smaller, not only must there be multilevel connections but the devices themselves must be arranged in a three-dimensional array to minimize chip size. Thermal compression bonds the two layers together.

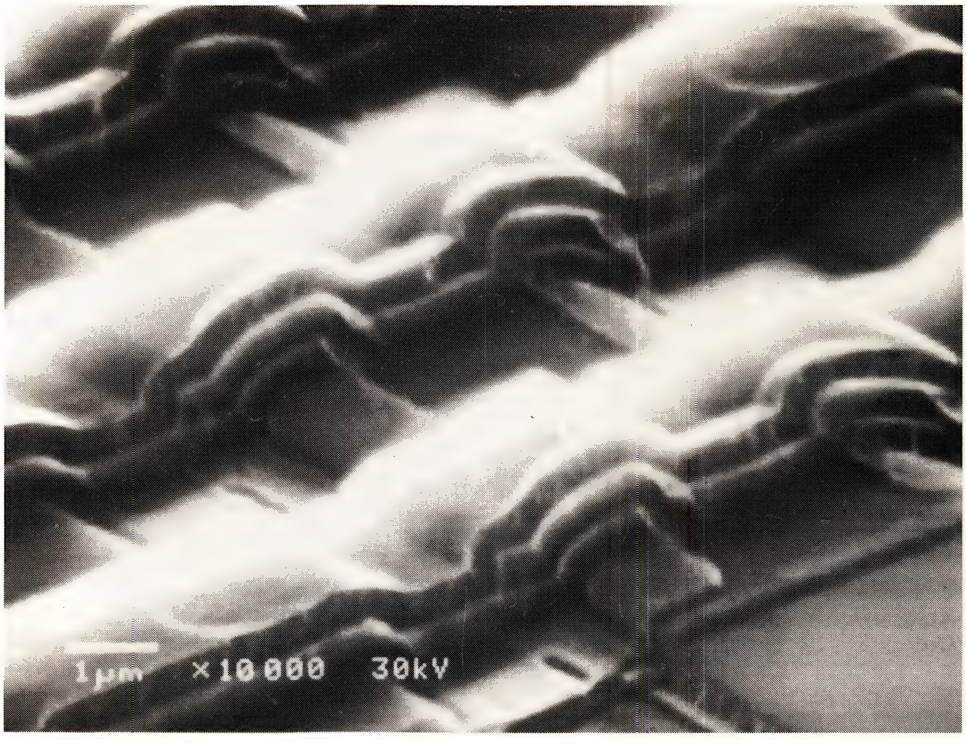
namic RAM with a 1.2-μm line width by avoiding all the sophisticated techniques such as trenching and silicides discussed by many other participants. The Mostek process begins with lightly doped p-type silicon, uses a localized-oxidation approach to create self-aligned, p-type twin-tubs, with conventional local oxidation and dual field-implants for device isolation.

Two poly layers are used, with transistors built of the upper layer (poly 2) and capacitors and tracked resistors built of the lower (poly 1). Toshiba Corp., Kawasaki, Japan, is using n-MOS technology in their 1-Mb DRAM, also with a 1.2-μm line width. While Toshiba uses a conventional flat-capacitor-type memory-cell structure, the substrate's capacitor area is maximized with buried oxide isolation (grooving and refilling with oxides). With this technique, Toshiba achieves a cell capacitance of over 40 fF while keeping chip size small enough to fit into a standard 300-mil dual in-line package.

The n-MOS chip uses poly-2 word lines shunted by aluminum, rather than more exotic choices such as refractories, to keep the process compatible with existing production lines. Standard two-level metalization is used, but the first aluminum layer is capped with $TiSi_2$ to suppress hillock growth and to increase resistance to electromigration.

Not all the 1-Mb efforts are based on maintaining a conservative process design. Mitsubishi's n-MOS megabit DRAM uses the silicides and refractory alloys that Mostek avoids. Its RAM has a 3.8-by-9.4-μm cell size (again with 1.2-μm line widths) and adopts a number of new methods to improve reliability. Epitaxial-growth wafers are used to keep the cell-plate bias voltage low. To improve access time, $TiSi_2$ polycide gates are used, with lamp annealing. Electromigration is halted by using an aluminum-silicon-titanium alloy, which is also convenient for dry etching. By combining all the latest processes, Mitsubishi claims to get a megabit RAM with the same reliability as current 256-K DRAMS.

One IC area that is not widely represented at the conference is wafer-scale integration. A group at the Massachusetts Institute of Technology's Lincoln Laboratories in Lexington, Mass., led by P.W. Wyatt, reports on progress in a restructurable VLSI process for wafers (Fig. 8). One chip, a 24-cm² digital integrator, has been successfully programmed. In restructurable VLSI, new connections can be made as well as old ones broken by laser. The new laser links use amorphous silicon coated with a 100-Å layer of SiO_2 as an insulator. A connection is made by melting through the insulator, while links are cut by laser evaporation of metal lines.



7. Shrinking EEPROMs. A self-aligned technology is used to reduce the area of the shielded substrate of this MOS EEPROM cell to a mere 57 μm². The tunnel oxide window and the read transistor are combined in the same structure using 2-μm design rules.

elaborate such sensors is a thermometer array developed at Stanford University, Palo Alto, by Phillip Barth and colleagues to monitor high-temperature treatments given to cancer patients. The array consists of two silicon islands interconnected by flexible gold leads, with both leads and islands embedded in a flexible polyimide layer. Each island contains a p-n junction diode that acts as the thermometer. The arrays are 1 mm wide and 0.4 mm thick and have been produced in lengths up to 20 cm. The Stanford group is now trying to apply the same technology to create sheets of force-sensors to be used on robots or prostheses.

Another medical sensor being developed at Stanford is a pressure sensor with on-chip signal conditioning. The piezoelectric sensor measures 1 mm by 0.6 mm by 5 mm and fits on the end of a medical catheter. The circuitry is at the bottom of a 5-μm-deep well, hermetically sealed with a glass-silicon anodic bond. A similarly sealed 0.5-mm^2 silicon sensing diaphragm is used for the pressure measurements.

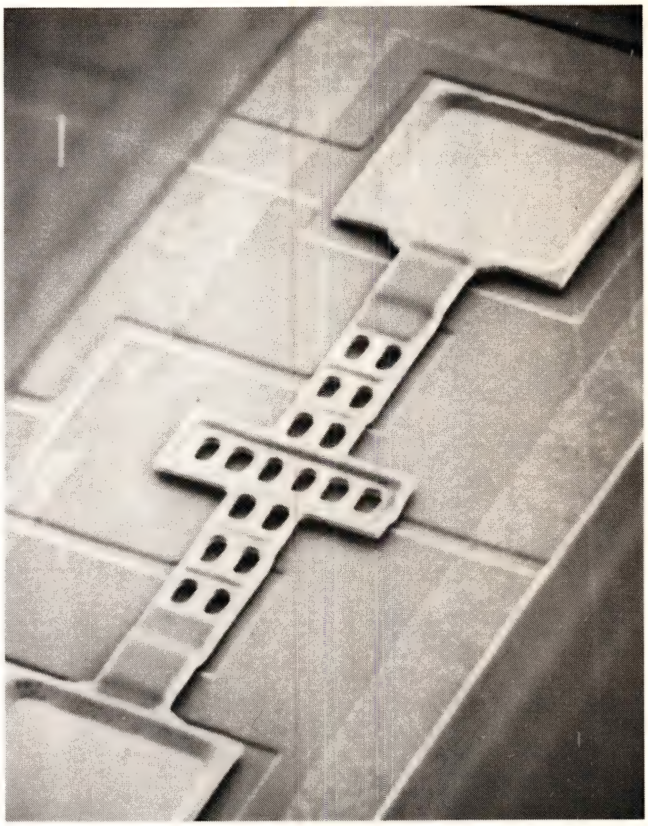
The sensor uses a novel form of lead attachment for corrosion resistance. Three V-grooves, 0.1 mm wide by 0.07 mm deep, are created in the wafer during fabrication. Bonding pads are built into the V-grooves and are then covered with glass. When the chips are diced from the wafer, the grooves become tunnels into which the leads can be soldered.

One particular type of sensor—photodetectors—is making especially fast progress, as CCD density increases rapidly. A.J.P. Theuwissen and colleagues at Philips Research Laboratories report on the development of an ultrahigh-density CCD-imager with 600 by 600 pixels on only 38 mm^2 (Fig. 11). The CCD, called the Accordion Imager, has pixels measuring 7 by 11 μm, using 3-μm minimum dimensions. It has about half the area of a conventional CCD.

The idea behind the Accordion Imager is to double the CCD's resolution without changing the number of electrodes. This is done by collecting charges at both odd- and even-numbered electrodes rather than only the odd ones, as is conventional. After the integration of the charges, the cells switch from a two-phase system to a four-phase system, one by one, and thus open up like an accordion. By the time the accordion is fully opened, half the charges have been transferred out; the other half are then moved out and the cells switch back to an integrating mode. CMOS electronics are integrated into the array, with the CCDs fabricated in a triple-poly n-buried-channel process.

High speed rather than high density is another goal of some photodetector researchers. S.Y. Wang at HP has come up with a GaAs Schottky-barrier photodiode with 100-GHz bandwidth. The device is formed from a semitransparent platinum film over n$^-$ or n$^+$ GaAs epitaxial layers grown on a semi-insulating GaAs substrate.

Perhaps the most dramatic advance is in sensitivity. Anne Chiang and N.M. Johnson of Xerox Corp., Palo Alto, report optical gains of as high as 1,000 electrons per absorbed photon, or 300 A/W, in a new type of photodetector. By comparison, typical amorphous silicon diode sensors have sensitivities of 0.5 A/W. The new detectors are n-channel depletion-mode thin-film transistors (Fig. 12). The depletion-mode TFT is fabricated by counterdoping the upper half of the channel region of an enhancement-mode thick-film transistor with phosphorus ion implantation. It achieves a photocurrent-to-dark-current ratio of nearly 106:1.



10. Better than a canary. A freestanding polysilicon microbridge is used to detect the presence of toxic vapors. The bridge's mass changes when the thin film applied to it absorbs the vapor. This in turn changes the resonant vibration frequency of the bridge.

Bigger is better

With circuits and sensors shrinking, power-device designers are after bigger and higher-frequency devices, both for use in heating thermonuclear fusion plasma and for radar. Klystrons are still being improved for microwave frequencies, but higher powers can be achieved with the new relativistic magnetrons, which can reach peak powers of 1 GW, according to G. Bekefi of MIT.

For higher frequencies, cyclotron masers such as the gyrotron are currently producing high-power millimeter waves, and free electron lasers are moving toward submillimeter and far-infrared ranges. At the present rate of progress, in a few years current sources of radiation will be available at high powers for frequencies stretching from dc to X rays, and the long-standing gap between near-IR lasers and electronically based oscillators will have closed.

A team from Toshiba Corp., at Kawasaki, Japan, and the Japan Atomic Energy Research Institute has successfully developed a 1-MW, 2.3-GHz klystron to be used for plasma heating. The device produces 10-s-long pulses that can be tuned to several different frequencies in the course of a single pulse.

At much higher frequencies, Varian Associates in Palo Alto, Calif., has tested a 60-GHz gyrotron with 200 kW

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AUTOMAKERS SHIFT TO PROCESSORS

Microprocessors in automotive systems improve fuel economy, keep emissions within legislated limits

☐ *by Richard Valentine and Jack Stewart*

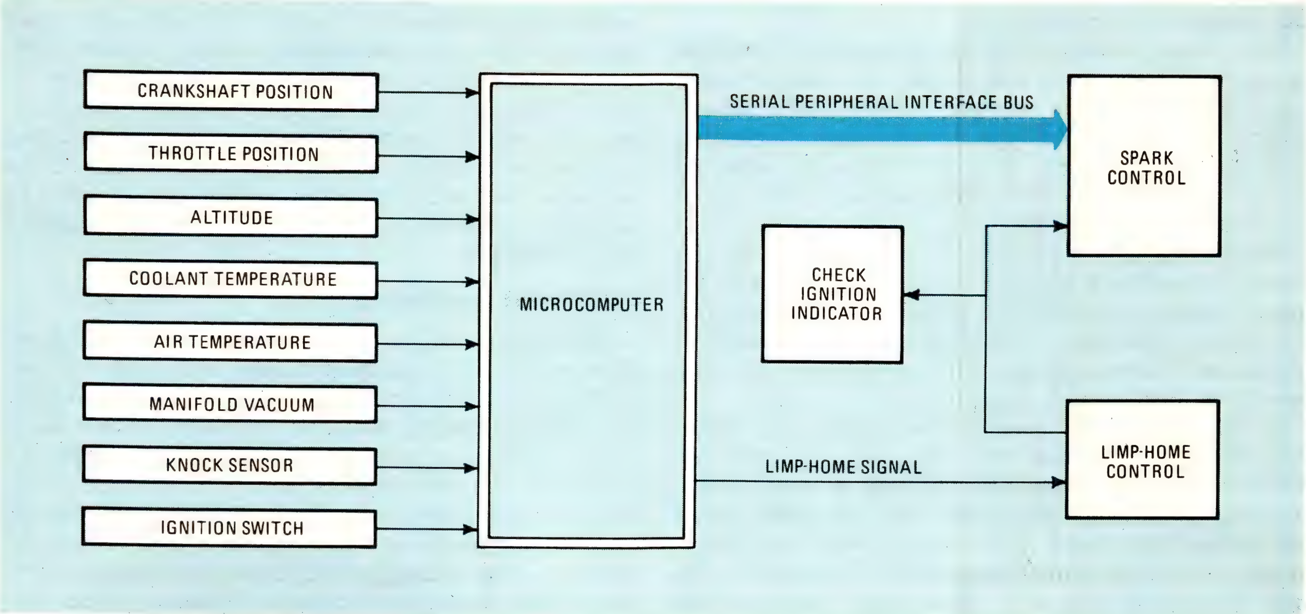
Electronic engine-control design has been a key point of automobile manufacturers during the 1980s, with more than $50 million already spent to develop systems that meet emission-control and fuel-economy standards. Such standards are currently legal requirements in the U.S. and Japan, with similar laws on the horizon in West Germany, Australia, Sweden, and Switzerland.

Most of the improvements made to the internal combustion automobile engine since its development have modified the mechanical and hydraulic systems, while the electrical system has remained essentially untouched. In the 1970s, however, high petroleum costs and legislated emission standards created a major problem for designers of new automobiles. What was needed was a closed-loop system of engine control—one that could continuously set fuel and ignition parameters, measure the resulting performance, and then reset those parameters while constantly seeking the best combination of engine adjustments.

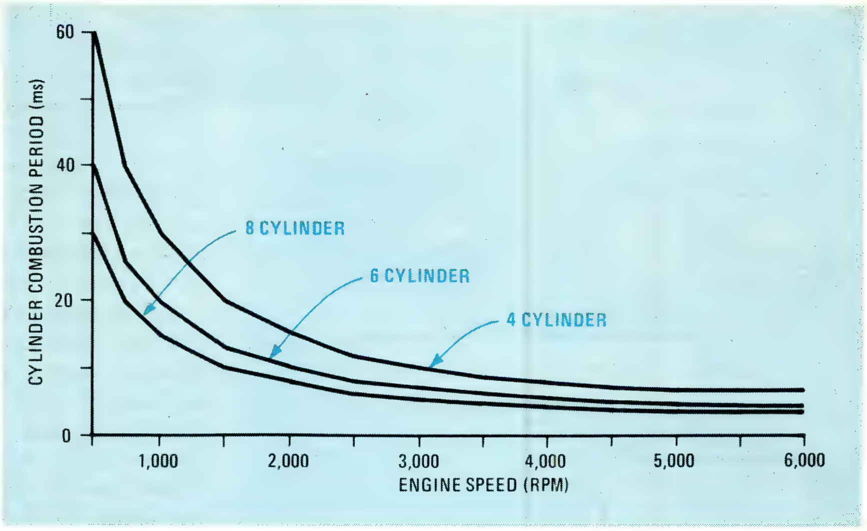
Fortunately, at the same time, the semiconductor industry introduced the powerful very large-scale integrated-circuit microprocessor. The microprocessor was found to be ideally suited to serve as an automobile engine controller, providing the necessary computing power, flexibility, reliability, and economy.

Controlled emission mandated

Early designs for four-cycle internal-combustion engines first used electrical control in ignition systems, where adjustments involved crankshaft timing and dwell time. Crankshaft timing, although augmented by automatic spark-advance mechanisms, was strictly mechanical and required frequent adjustment to compensate for wear. The dwell time, or spark-coil on time, was set by adjusting the spark-coil points to a specified gap. Because of mechanical wear and electrical arcing, the points



1. Spark timing. Optimum spark timing and width can be set using one of the microcomputer's timers to monitor the engine's crankshaft angle, while the other timer establishes the spark timing profile. One microprocessor can monitor up to eight inputs.



3. Timing relationships. An eight-cylinder engine running at 6,000 rpm requires 13.5-μs timing resolution to maintain a 0.5% crankshaft-angle timing accuracy. A microcomputer with three 16-bit shift registers is necessary.

been the development of the distributorless ignition, which uses special spark-plug coils that fire two plugs at a time. The result is the attainment of a new level of precision in fuel and spark control as well as the elimination of some mechanical-failure mechanisms.

Comparable developments in the control of fuel to the engine cylinders have also occurred. Fuel control is perhaps the most difficult engine system to design, because it must be extremely reliable and yet be cost effective.

Electronic fuel-injection systems based on discrete analog and digital devices, introduced in the late 1960s, turned out to be unproven, bulky, and cumbersome and were soon replaced with the tried and proven mechanical fuel-injector system.

Interest in electronic fuel injection resurfaced when it was recognized as a useful way to meet federal emission-controls requirements. This time, however, the microprocessor was combined with a simple air-to-fuel mixing device when General Motors Corp. introduced throttle-body fuel injection in the late 1970s; the same basic system is used today.

The microcomputer fuel-control system actually does more than just routinely mete out fuel at a given rate. The fuel delivery rate is governed by several input variables including throttle position, intake air-flow mass, and temperature, which are sensed to produce the optimized fuel-to-air mixture.

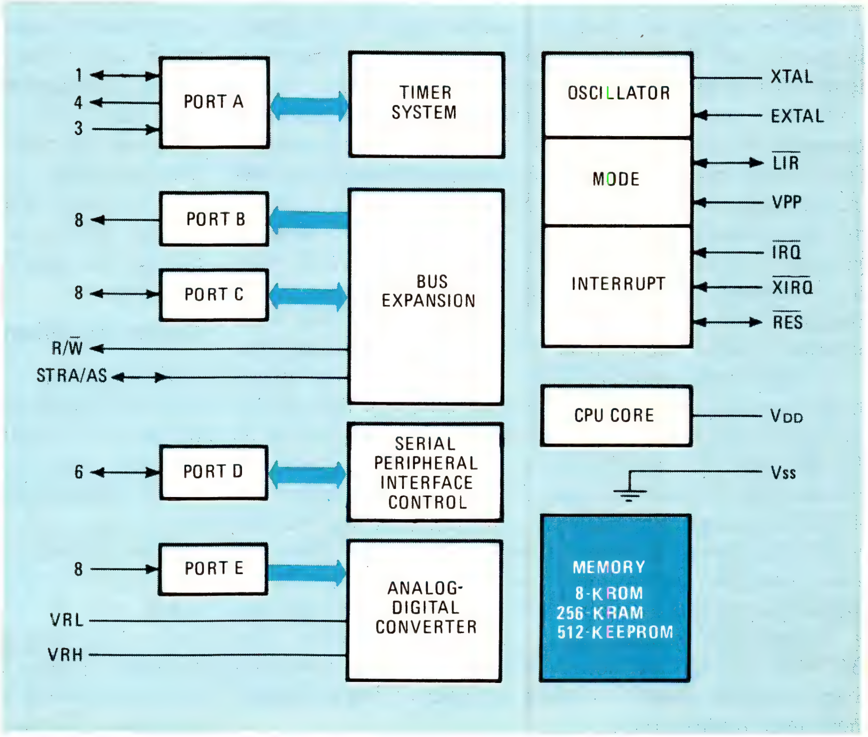
The exhaust gas is also monitored for chemical content, and the system can fine tune the fuel-to-air mixture while the engine is running. In effect, the engine runs in an open-loop mode for certain conditions, such as high acceleration demands, then operates in a closed-loop mode for meeting emissions standards during regular driving. A conceptual microcomputer-based engine-control system (Fig. 2) may be included in late 1980s models.

When failures occur in the engine-control system, it is important that the automobile does not become completely disabled. This is done by adding a circuit containing fixed fuel and ignition system parameters into the critical control signal lines to the fuel and spark circuits. If a control electronics failure occurs, the backup nonsmart circuit presets the fuel and ignition systems so that the vehicle can still be driven.

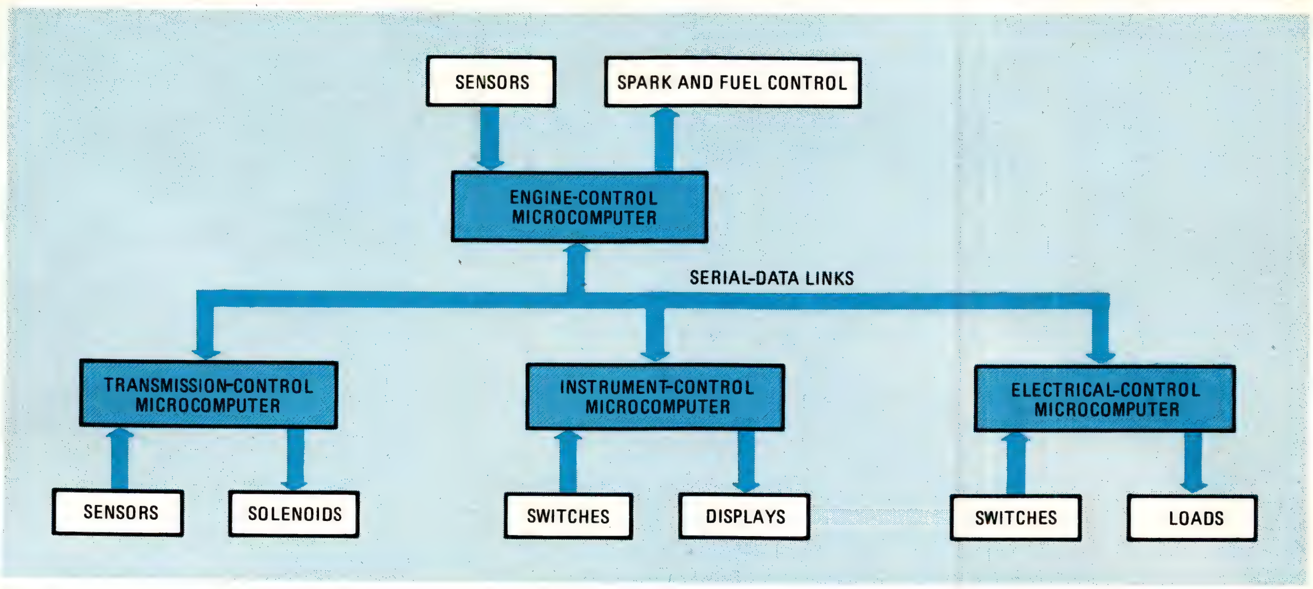
A look at the technical requirements of an electronic microcomputer engine-control design reveals that a powerful digital processor and input/output structure is needed. It is critical that the timing relationship between engine speed and the cylinder combustion period for four-, six-, and eight-cylinder engines be precise (Fig. 3).

Microprocessor requirements

An eight-cylinder engine at 6,000 rpm requires a timer resolution of 13.5 μs to maintain a 0.5% crankshaft-angle timing accuracy. This requirement may be achieved by a microcomputer such as the Motorola MC68HC11 (Fig. 4); its architecture includes three general-purpose



4. Chip architecture. Thanks to the MC68HC11 microcontroller's 512 bytes of electrically erasable read-only memory, each control system can be optimized without the need for the automobile manufacturer to change or stock masked ROM chips.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6. Vehicle systems. The four vehicle-control systems are connected together with a serial-data bus, permitting important functional data to be interchanged. For example, the engine loading data is available to the transmission control to set the optimum gear ratio.

spikes generate troublesome electromagnetic radiation interference, making traditional automobile wiring systems candidates for redesign.

Although it is certainly possible to add required communications paths into standard automobile wiring harnesses, much care is necessary to minimize electromagnetic-interference pickup and radiation. One technique for reducing this is to use a slow data rate with a high error-checking and -correcting protocol. If there is a need for a fast data rate, then an alternate data link must be used. Coaxial cable is not effective because of possible high-current ground loops through its shield. Twisted pairs feeding into isolation and impedance-matching transformers work well with telephone equipment but may not be cost effective for automotive use. Fiber-optic data links hold the most promise for a trouble-free data link in the automobile. Low-cost optoelectronic devices have been introduced recently to fill this need.

Remaining problems

An automobile engine compartment provides a severe operating environment, with temperature extremes especially rigorous. Electronic components and systems must be designed for reliable operation from under-hood temperatures of 125°C and high battery voltage (up to 16 V) to –40°C with a battery voltage of only 5 V during engine cranking on a cold winter night. Further developments in engine-control electronics will call for more measurements and calculations than now used, and these will have to be increasingly precise.

Currently, the typical resolution of an analog-to-digital converter found on a microcomputer is 8 to 10 bits. If signals vary between 0 and 5 V, the microcomputer can resolve from 0.0196 to 0.0048 V. The analog-to-digital resolution must be matched with sensor sensitivities to achieve optimum performance.

Another concern is the internal precision of the microcomputer structure. An 8-bit number will resolve only to a 0.39% error, whereas a 16-bit number will resolve to a 0.0015% error. It is critical that the registers used for calculations be large enough to retain sufficient accuracy.

An engine-control microcomputer instruction set should be flexible enough to be effective for all on-board automotive application needs. It should allow programmers to use a common language from one application to another and from each generation of automobile to its succeeding generation, requiring a highly efficient cross-assembler. As a first step in this direction, new engine control microcomputers will include powerful instructions for mathematical calculations such as multiply and divide, signed or unsigned. Automobile serviceability is an area where microcomputer engine control will contribute greatly in the future. On-board microcomputers combined with EEPROMs will make detection and preliminary analysis of faults practical and economical.

IC packaging for automotive electronics is changing because of new automated manufacturing methods, high pin counts, and the ongoing need for very efficient heat dissipation. The solutions to these packaging problems are varied. However, it seems clear that today's flip-chips, dual-in-line packages, and ceramic DIPs are giving way to plastic-leaded chip-carriers, small-outline ICs, and single-in-line packages which, in turn, will be displaced by tape-automated bonding.

As 16- and 32-bit microprocessors are developed, their microcomputer counterparts for automotive applications will soon follow. Future automotive systems will include Motorola's SMART-power (logic and load-handling) technology, with microcomputer logic functions implemented into the load switch element. For example, if a digital load-switching system is used to control remote actuators or lamps, the SMART-power load switch could include logic to monitor the actuator or lamp for failure. If a failure is detected, the master control system would be alerted so that corrective action can be taken. □

Richard Valentine is an automotive systems engineer and Jack Stewart is automotive strategic marketing manager at Motorola Semiconductor Products Sector, Phoenix, Ariz.

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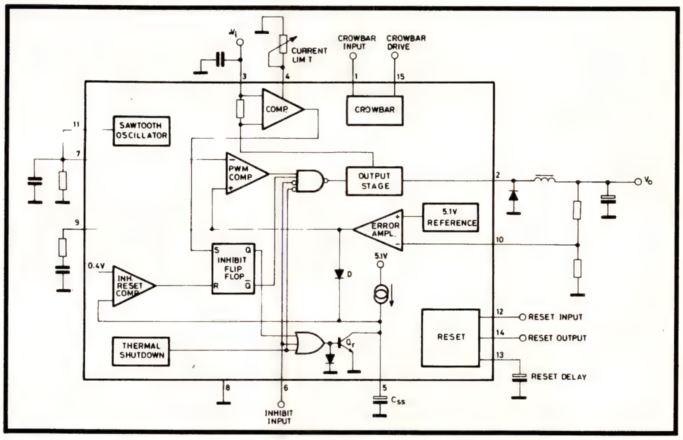

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PROGRAM MAKER HAS CAD-LIKE FEATURES

Latest version of the Factory application generator uses diagramming techniques to illustrate the logical flow of programs

☐ *by Steve Zollo*

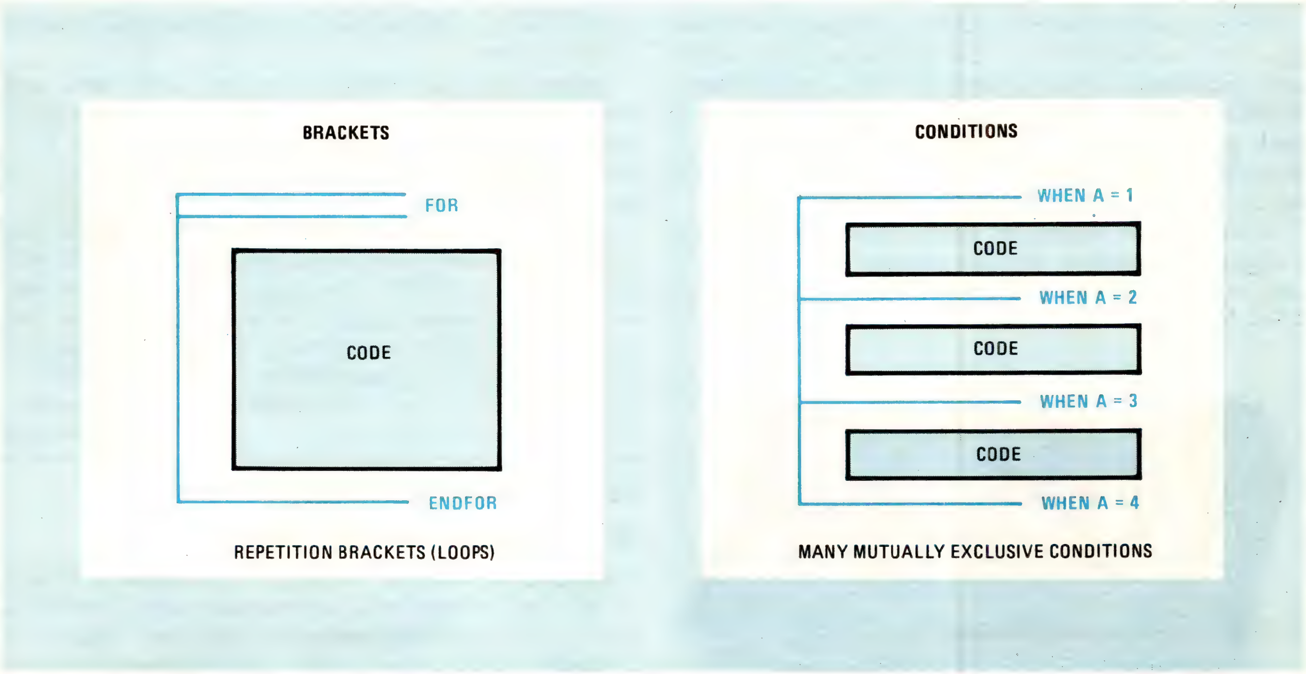
Just released, the latest version of the Factory, Cortex Corp.'s automated application development tool, features a computer-aided-design-like visual programming aid and an advanced report generator. Running on a Digital Equipment Corp. VAX computer under VMS, the Factory includes an application generator and integrated fourth-generation language called Builder.

What CAD is to designers, the Factory is to programmers: it automates the development of on-line business applications. From user specifications entered interactively at a terminal, the Factory constructs general business applications complete with screens for data entry, data updating, data retrieval, reports, computations, and database management. The Factory generates applications that can run on PDP-11 and the Professional 350 computer as well as on VAX.

One of the new features in Version 2.5, the action diagrammer, is a visual programming aid that automatically displays the logical flow of a program in a concise and easy-to-understand manner. "Graphically oriented computer-assisted-programming techniques represent a major breakthrough in computer programming," according to Craig Hill, president of Cortex.

The Action Diagrammer is a graphical language editor that provides a visual representation of very-high-level program code to facilitate the addition of sophisticated program logic to generated code. The editor also checks the syntax and consistency of code while it is being entered on line. The action diagrams produced graphically depict the structure and flow of program logic that makes program code easy to read and understand.

The advanced report generator incorporated into Ver-



Boxed in. Action diagramming uses brackets to show a program's control structure. Brackets with a single line at the top indicate control structures that are executed once; a double line at the top indicates a group of operations that are repeated.

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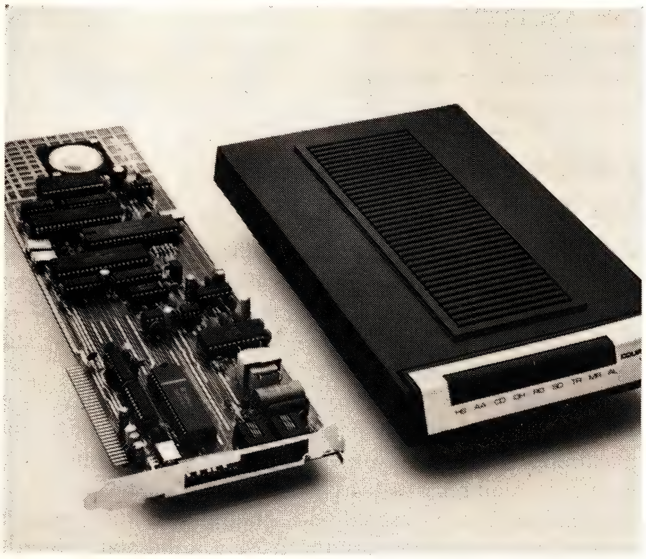


as many toll-free numbers) and converts them to numeric form before dialing.

Both models are auto-dial, auto-answer asynchronous modems, compatible with the International Telephone and Telegraph Consultative Committee V.22 bis (USA) standard at 2,400 bits per second, Bell 212A at 1,200 b/s, and Bell 103 at 300 b/s. The manufacturer feels that the advanced signal-filtering technology necessary for 2,400 b/s transmission results in exceptional technical performance at the lower rate of 1,200 b/s.

Both modems are configured on a single board, with only 17 integrated circuits. The Microlink 2400, designed to occupy a full-sized single slot in the IBM Corp. Personal Computer and its compatibles, also includes the manufacturer's proprietary telecommunications software, Telpac. The Courier 2400 model may be used with any computer or ASCII terminal equipped with an RS-232-C serial interface and offers a nine-function light-emitting diode display panel.

The suggested retail price for both models is $895, and they will be available in January 1985.

U.S. Robotics Inc., 1123 W. Washington Blvd., Chicago, Ill. 60607. Phone (312) 733-0497 [Circle 354]

User can switch modem from CCITT to Bell standard

Meeting both the international and Bell standards for data communication at 300, 600, 1,200, or 2,400 b/s, the Smartmodem 2400 permits the user to switch transmission rates by issuing a command to the modem. The modem operates both synchronously and asynchronously, which enables it to link terminals, personal computers, mainframes, and information utilities.

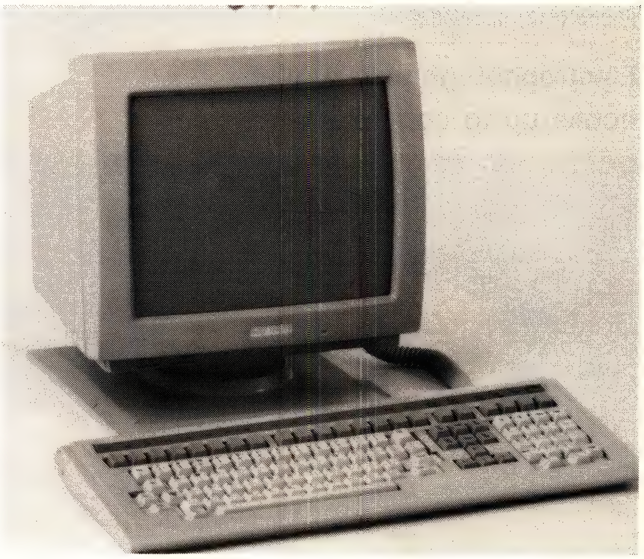
Features include call-progress monitoring, voice-data switching, and the ability to set communications instructions with keyboard commands instead of mechanical switches—commands that can be permanently stored in nonvolatile memory. The commands employed are a superset of the manufacturer's AT command set.

For compatibility with long-distance carriers such as MCI or Sprint, the Smartmodem 2400 waits for a second dial tone before dialing additional digits or commands. The modem also responds to the "quiet answers," a period of silence following a connection, standard on Rolm and much private branch exchange equipment.

The Smartmodem 2400 comes with a transformer, modular phone cable, and user's manual. Its estimated retail price is $899. Available in January 1985, units will be shipped within six weeks.

Hayes Microcomputer Products Inc., 5923 Peachtree Industrial Blvd., Norcross, Ga. 30092. Phone (404) 449-8791 [Circle 355]

VT220-compatible terminals to be available in quantity



The largest Taiwanese electronics concern, Tatung, promises January availability of VT220-compatible terminals at a price 40% lower than those hard-to-get terminals made by Digital Equipment Corp. When available, the TVT-7220 display terminal will be priced at $850 each. The company says it will initially be able to deliver from 4,000 to 6,000 terminals a month.

In addition to full VT220 terminal emulation, the TVT-7220 features a larger screen—14 in.—an ergonomic tilt and swivel enclosure, and emulation of the DEC VT100 and VT52 terminals as well. The firm is also introducing the MM-1222 and MM-1225, two 12-in. monochrome monitors priced at $230 each.

Tatung Co. of America Inc., 2580 El Presidio St., Long Beach, Calif. 90810. Phone (213) 637-2105 [Circle 352]

Laser printer uses cartridges to download type fonts

Suitable for multiuser or single-user systems, the LN03 laser printer puts out eight pages/min, equivalent to 333 characters/s. The LN03's print density is 300 dots/in., and simple business graphics can be produced at resolutions of up to 150 dots/in. Resident fonts allow the

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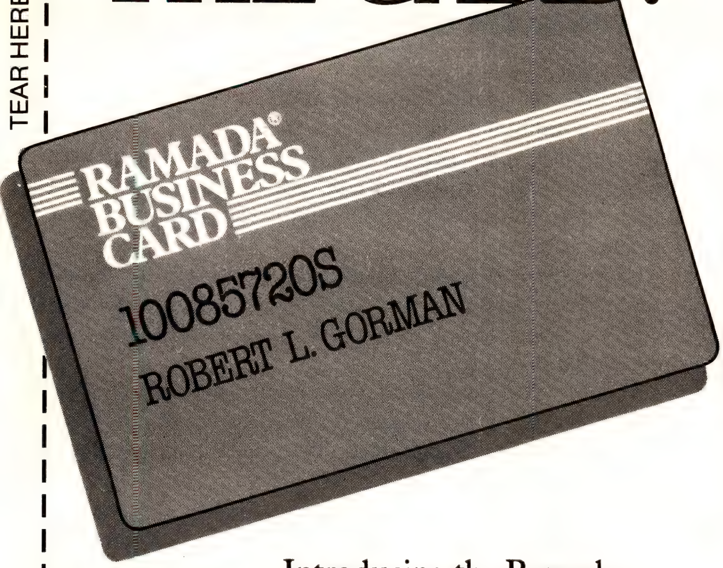

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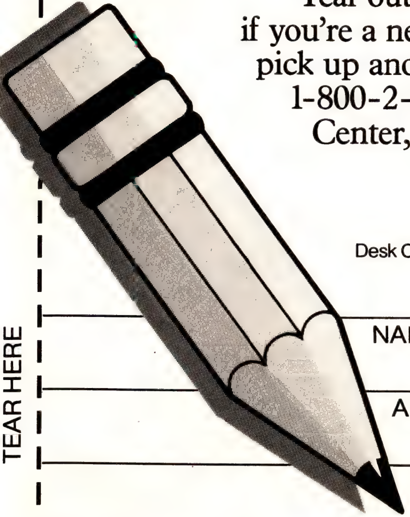

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NCR45CG72, are now available in 84-pin ceramic pin-grid-array packages for $545 each; 84-lead, plastic J-lead chip carriers selling for $495 each will be available in the first quarter of 1985.

NCR Corp., Microelectronics Division, 2001 Danfield Ct., Fort Collins, Colo. 80525.
Phone (303) 226-9500 [Circle 364]

GaAs cell array builds both digital and analog circuits

The semicustom gallium arsenide Quick Chip cell array, which supports digital circuits with clock rates up to 2 GHz and analog circuits with bandwidths to 5 GHz, is said by the manufacturer to run three to five times faster than emitter-coupled-logic circuits currently in use. The Quick Chip targets applications in mixed analog and digital systems, such as fiber-optic links that transmit in the gigabit-per-second range, parallel-to-serial-to-parallel data conversion, and very high-speed signal encoder/decoder circuits.

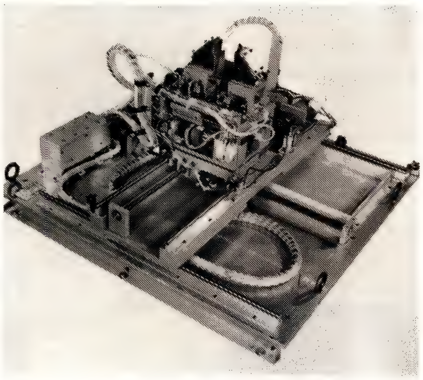
The semicustom array is built in a mature GaAs depletion-mode process that has a much higher speed capability than comparable silicon processes. Circuits can be built by the digital or the analog process, and Spice transistor models and standard transistor layouts are available to assist the analog designer. More complex circuits, such as those using capacitors and precision resistors, can also be built.

Available in an 0.42-in.^{2} ceramic leadless chip carrier and socket assembly for prototype testing, the Quick Chip array carries a price tag of $55,000.

Tektronix Inc., P.O. Box 500, Beaverton, Ore. 97077. Phone (503) 644-0161
[Circle 385]

Cut-and-clinch head operates in robotic assembly setting

The variable-center-distance cut-and-clinch head of the CC-1084 has a footprint of 0.1 in.^{2} and can accept components with wire up to 0.048 in. in diameter and lead centers from 0.2 in. to 2.3 in. A stepper-motor-driven X-Y table lets the system handle printed-circuit boards up to 18 in.^{2}. The unit offers RS-232-C compatibility, adjustable clinch angle and cut length, 90° head rotation, and a resolution of 0.001 in.



The CC-1084 is delivered 15 weeks after ordering. Pricing information was unavailable.

Heller Industries Inc., 4 Vreeland Rd., Florham Park, N.J. 07932.
Phone (201) 377-6800 [Circle 366]

Microwave probing tools test wafers through 18 GHz

A probe station and two series of probe cards have moved the art of performing on-wafer measurements from under 1 GHz up to 18 GHz. The model 42 microwave research and development probe station is a manual wafer-probing station that provides reconfigurable probe footprints while allowing multiple connections to coaxial cables. Using four three-axis positioners for mounting up to four probe heads, the model 42 can examine each side of the device under test.

The model 42 comes with eight probe heads, two Impedance Standard substrates, a standard probe-card adapter, a microscope with coaxial and oblique lighting, and more. The series 1000 and 2000 probe cards are compatible with standard 4.5-in. mounts. They consist of one probe-head footprint on one to four sides of the device being tested. The series 2000 also provides integral low-frequency needle-type probes for power supplies, bias, and other properties.

Both the probe station and the probe cards come complete with calibration standards to calibrate one-port or two-port measurements at

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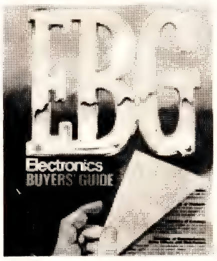

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Ore., the new portable is intended for technical end-users and value-added resellers who want an entry-level transportable Unix machine. HP says the machine will go for under $5,000 for unit sales.

When Unix applications reach the office, the portable will be sold to business professionals, says product marketing manager Sal D'Auria. The new machine is run by a Motorola 68000 microprocessor and an HP-built graphics coprocessor. System software is based on the AT&T System III Unix and the HP-UX Unix extensions, including a window manager and the personal applications manager (PAM) that HP first introduced in its 150 Personal Computer, as well as the Programmer's Workbench and some communications software.

The system supports program development in C, Pascal, Fortran, and technical Basic. It is data-file- and source-code-compatible with HP's earlier Unix machines, the Series 200 and the Series 500, and object-code-compatible with the 200.

Its standard memory configuration is 800-K bytes. The display has a resolution of 512 by 255 pixels. The printer is HP's 150-characters-per-second Thinkjet. A mouse is optional. Expansion is possible through a built-in IEEE-488 interface and two expansion ports, plus a bus expander.

Hewlett-Packard Co., Inquiries Manager, 1820 Embarcadero Rd., Palo Alto, Calif. 94303 [Circle 387]

Multitasking work stations can stand alone or run in net

Computer-aided engineering applications receive a boost from two work stations, models 10 and 20, based on the Bell Laboratories Unix System V operating system. The central processing unit in each station uses dual 32-bit microprocessors: a 68010 and a 68000 running at 10 MHz. The graphics processor is 68000-based, with 128-K bytes of program memory and up to 1.2 megabytes of display memory that runs independently of the CPU.

Packaged as a stand-alone unit, the basic station includes a 32-bit CPU with three RS-232-C lines, 1

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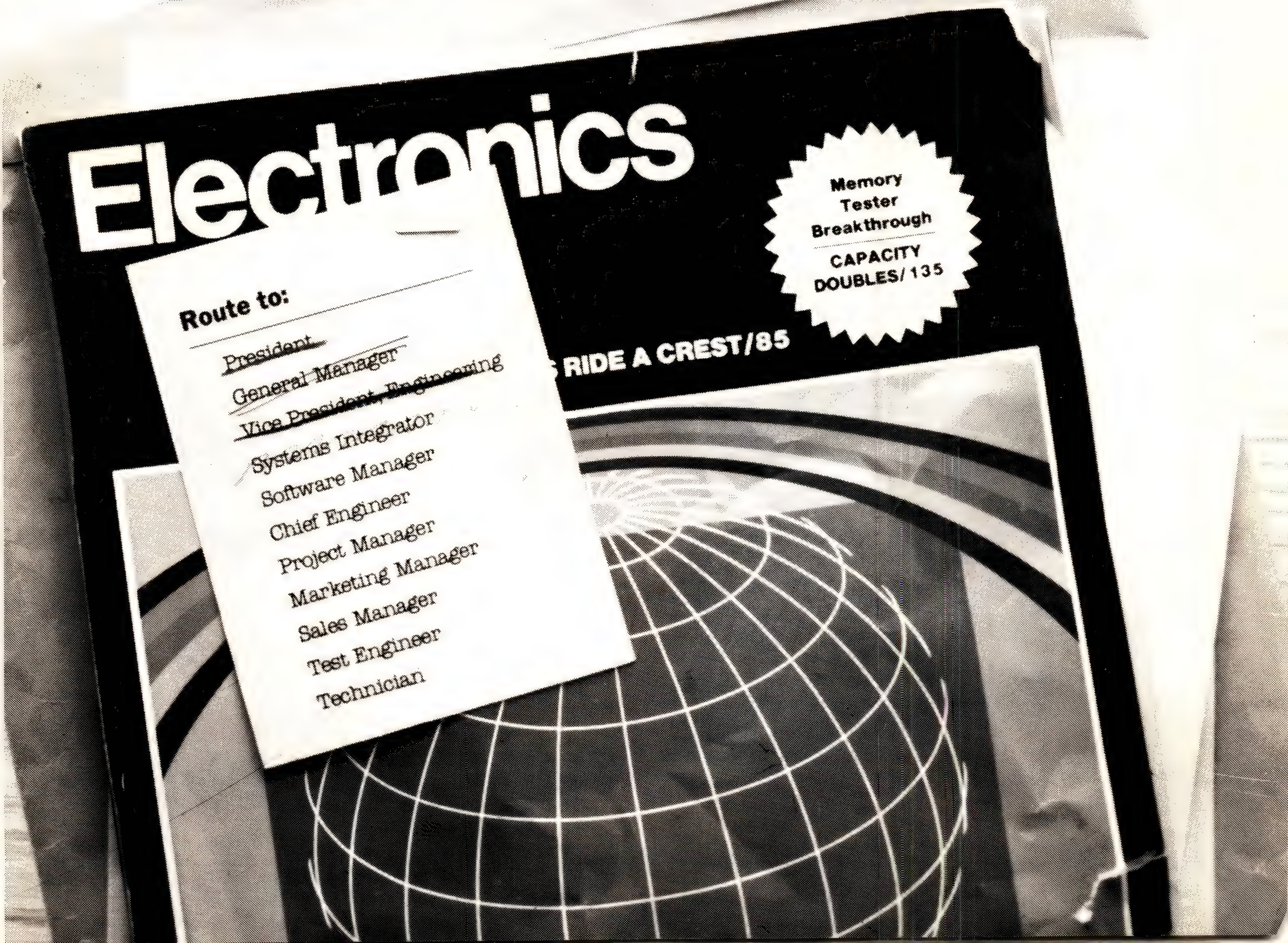
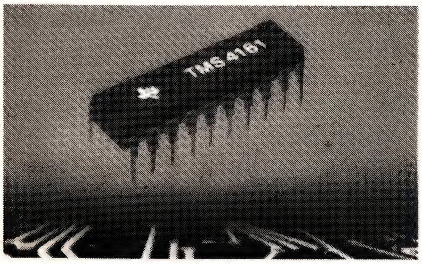


and a "flip" key is provided that allows data to be compared from two different applications.

Ability, which is priced at $495, is configured to run on an IBM Corp. Personal Computer having at least 256-K bytes of memory and two disk drives, plus a color monitor. Shipments will begin at the end of January 1985.

Xanaro Technologies Inc., 321 Bloor St. E., Suite 815, Toronto, Ont. M4W 1G9, Canada. Phone (416) 927-8369 [Circle 357]

Dual-port video DRAM treats text as graphics



By providing up to 97% of the available memory cycles to the processor, the TMS4161 gives the processor sufficient access to memory to treat text as graphics, thus eliminating the need for a separate text controller. It also allows the display memory and system memory to share the same data bus and control hardware.

Combining a 64-K dynamic random-access memory with a 256-bit shift register, the TMS4161's dual-port architecture allows a graphics (or host) processor to operate on the DRAM portion of the device while the shift register simultaneously and asynchronously provides pixel data to refresh the display. Thus, access to the display memory data bus is not blocked by cathode-ray-tube refreshes, a common graphics problem.

In bit-mapped display applications, the TMS4161 supports dot rates from 5 to over 150 MHz, interlaced or noninterlaced displays, and a variety of screen configurations. In addition, the serial-input port targets nonvideo applications that require sequential data streams combined with random-access capability.

The TMS4161 is offered initially in a 20-pin dual in-line package, in two models with different access times. In 100-piece quantities, the TMS4161-15 (150-ns access time) is priced at $9.90, and the TMS4161-20 (200-ns access time) is priced at $9. Both are available now.

Texas Instruments Inc., Semiconductor Group, Literature Response Center (SC-449), P.O. Box 809066, Dallas, Texas 75380. [Circle 386]

64-K static RAM and 16-K dual-port RAM come in CMOS

A 64-K CMOS static random-access memory and a 16-K CMOS dual-port RAM are organized as 16-K by 4 bits and 2-K by 8 bits, respectively.

The IDT7188 static RAM has access times as fast as 55 ns, with maximum power consumption of 495 mW. Its reduced-power standby mode enables designers to reduce device power requirements. All inputs and outputs are TTL-compatible and operate from a single 5-V supply. It is packaged in a 22-pin, 300-mil dual in-line package for board-level packing densities.

The IDT7132 dual-port RAM provides two ports with separate controls, address, and I/O lines that permit independent access for reads or writes to any location in memory. Access time as fast as 90 ns are available with typical operating power of 320 mW. It is packaged in either a 48-pin DIP or a 48-pin leadless chip carrier. The IDT7132 is priced at $324 each in lots of 100 pieces; samples will be available in the first quarter of next year.

Integrated/Device Technologies Inc., 3236 Scott Blvd., Santa Clara, Calif. 95051. Phone (408) 727-6116 [Circle 368]

16-K static RAM eliminates excess control circuitry

A 16-K CMOS static random-access memory, the MK48CO2, is designed for battery-backup-protected memory and eliminates the need for external power-fail detection and battery-switching circuitry.

Unlike electrically erasable programmable read-only memories and other nonvolatile memories, the MK48CO2 has write-protection circuitry that prevents spurious data from being written to the RAM as

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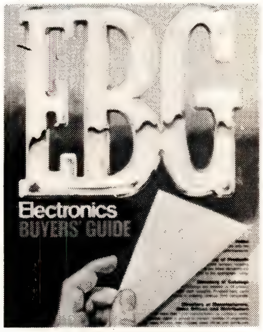

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An automatic adhesive dispenser, the EFD 1000DV, uses a vacuum pickup pencil to place small chips or components in the deposited fluid. One operator controls both the dispensing barrel and the pencil. A timed air pulse displaces a measured amount of the fluid, and an internal vacuum transducer and analog gauge function to prevent dripping between dispense cycles. The 1000DV requires a 115-V ac power supply and up to 100 lb/in.^{2} of factory air. Priced at $647, delivery of the unit is from stock.

Electron Fusion Devices Inc., 977 Waterman Ave., East Providence, R.I. 02914. Phone (401) 434-1680
[Circle reader service number 421]

Tantalum furnace shields, rigidized to reduce warpage, are recommended for high-temperature vacuum operations by the manufacturer. Because the rigidized design uses a thinner layer of tantalum than did previous models, material costs are reduced. Furnace parts include tantalum heating elements, side, top, and bottom shields, and mounting hardware. The shields are custom-manufactured to user specifications.

NRC Inc., 45 Industrial Plaza, Newton, Mass. 02154.
Phone (617) 969-7690 [Circle 422]

Molded Lexan resin carrying cases for transporting or shipping components and equipment are water-resistant, lightweight, and nonconductive, according to the manufacturer. Latches are of industrial strength, and padlock eyes permit the case to be secured to a fixed object with a chain. The LF series cases are 14 in. wide by 21 in. long; the LC series are 9¼ in. wide and 14 in. long, and both come in heights of 4, 5, or 6 in. Expansion modules are available.

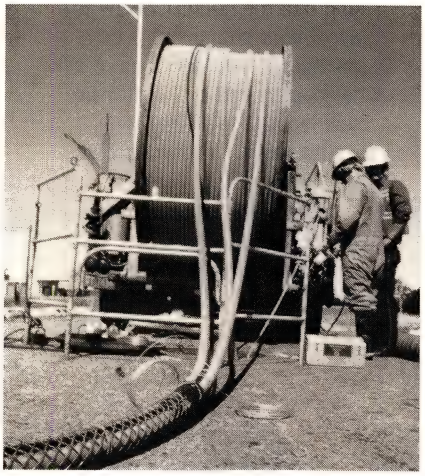
TSE Inc., 541 E. Hector St., Conshohocken, Pa. 19428. Phone (215) 825-8202
[Circle 423]

Bar-code labels, sequentially numbered and made of aluminum-base material, are recommended by the manufacturer for very harsh application environments. Compu-metal labels offer a print-contrast ratio of 90%. They come in a variety of thicknesses and in ultrahigh densities (15 characters/in. and above); the "X dimension" tolerance is under 0.001 in., and narrow elements as small as 0.004 in. are available.

Computype Inc., 2285 West County Rd. C, St. Paul, Minn. 55113. Phone (800) 328-0852 [Circle 424]

A pressure-sensitive spacer material for flexible-membrane switches, called Y-7958, is an 8-mil-thick product with 1½ mils of clear acrylic adhesive on each side. It is intended to meet medium-to-high bonding-strength requirements. The Y-7958 spacer has a dielectric strength of 13,000 V and resistance to temperatures up to 350°F. Protected by a 58-lb polycoated kraft liner, it is available in 24-by-36-in. sheets.

3M Co., Converter Specialties Division, Department IS84-108, P.O. Box 33600, St. Paul, Minn. 55133. [Circle 425]



A cable path and separation for fiber-optic and TV cables, from Duct/Innerduct, is designed for direct burial of cables or installation in underground ducts. The polyethylene product comes with smooth walls or corrugated walls, in several sizes, and is available with a pulling rope or tape preinserted during extrusion. It is said to have high resistance to stress and abrasion, and the low friction coefficient eases cable insertion.

Phillips Driscopipe Inc., P.O. Box 83-3866, 2929 N. Central Expwy., Richardson, Texas 75083. Phone (214) 783-2666
[Circle 426]

Custom thin-film metallized wafers and substrates, the HCN series, are offered in a choice of substrate materials, from 3 in.^{2} down to 0.02 in.^{2}. Precision NiCr-Ni-Au and Cr-Ni-Au metallization systems are standard, and each system is available in patterned or unetched form. Dimensional tolerances are offered to the user's specification, down to 1 µin. The HCN series includes microwave substrates. Prices of wafers typically range from $30 to $60, in 100-piece quantities. Prices of substrates go from $2 to $40, in 1,000-piece quantities. Delivery time is 3 to 12 weeks.

HyComp Inc., 75 Union Ave., Sudbury, Mass. 01776. Phone (617) 443-4631
[Circle 430]

A series of custom polyimide solutions—adhesion promoters, an etcher and rinse, a photoresist stripper, and a thinner-liftoff solvent—is designed for high-performance microelectronic application. The solutions are stable at room temperature and require no high-temperature cure. Consequently, the manufacturer says, film coatings have a low defect density. Films made from these solutions are resistant to acids, bases, and aqueous solutions.

Ciba-Geigy Corp., Resins Department, 3 Skyline Dr., Hawthorne, N.Y. 10532.
[Circle 428]

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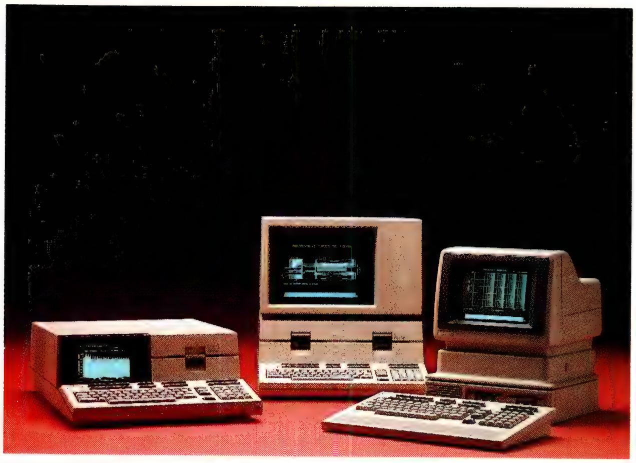

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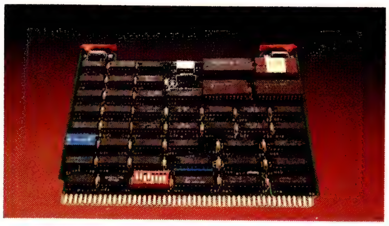

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Function	Computer Without Either Card	H-P's Math Card	Ratio	Infotek's FP 210 (10MHz)	Ratio	Computer Without Either Card	H-P's Math Card	Ratio	Infotek's FP 210 (10MHz)	Ratio
Add	166	124	1.3	112	1.5	127	74	1.7	60	2.3
Subtract	178	124	1.4	112	1.6	140	74	1.9	60	2.1
Multiply	316	124	2.5	113	2.8	278	74	3.8	64	4.3
Divide	450	128	3.5	117	3.8	416	78	5.3	65	6.4
SQRT	1960	627	3.1	241	8.1	1914	292	6.6	227	8.4
SIN	4093	1002	4.1	524	7.8	3952	618	6.4	496	8.0
COS	4493	1170	3.8	572	7.9	4383	678	6.5	549	8.0
TAN	4223	1075	3.9	519	8.1					
ASN	5369	1192	4.5	641	8.4					
ACN	5367	1195	4.5	644	8.3					
ATN	4415	1026	4.3	533	8.3	4615	665	6.9	545	8.5
EXP	3730	1050	3.6	496	7.5	3605	633	5.7	477	7.6
LOG	3982	1112	3.6	501	7.9	3904	551	7.1	487	8.0
LGT	4245	1183	3.6	533	8.0					
POWER	7799	2555	3.1	1117	7.0					

NOTE: The execution times are in microseconds and are based on a large sample of random numbers.

INFOTEK SYSTEMS, 1400 N. Baxter St., Anaheim, CA 92806, **Toll free (800) 227-0218,** From California, Alaska, Hawaii collect (714) 956-9300, EXT. 88, TELEX 182283

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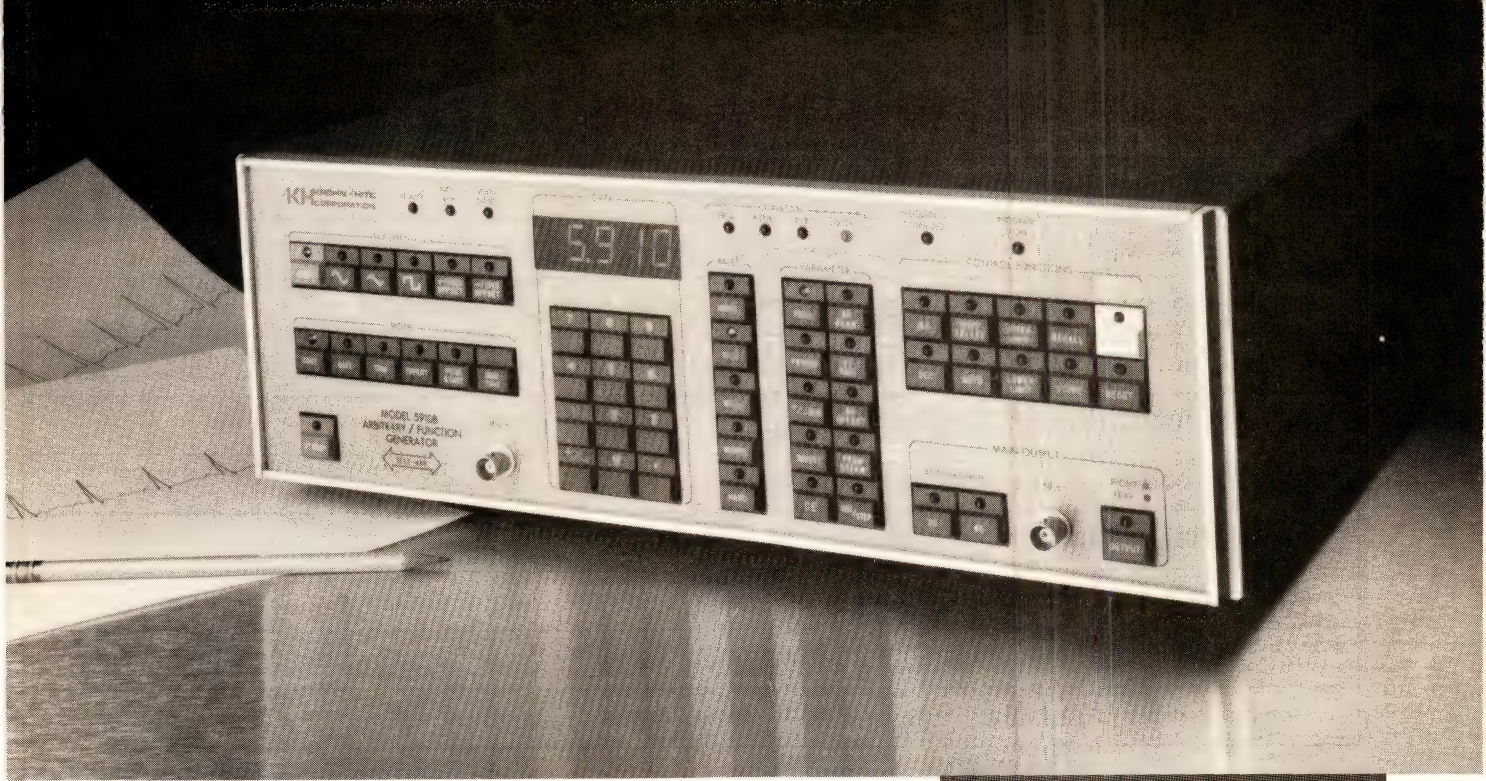

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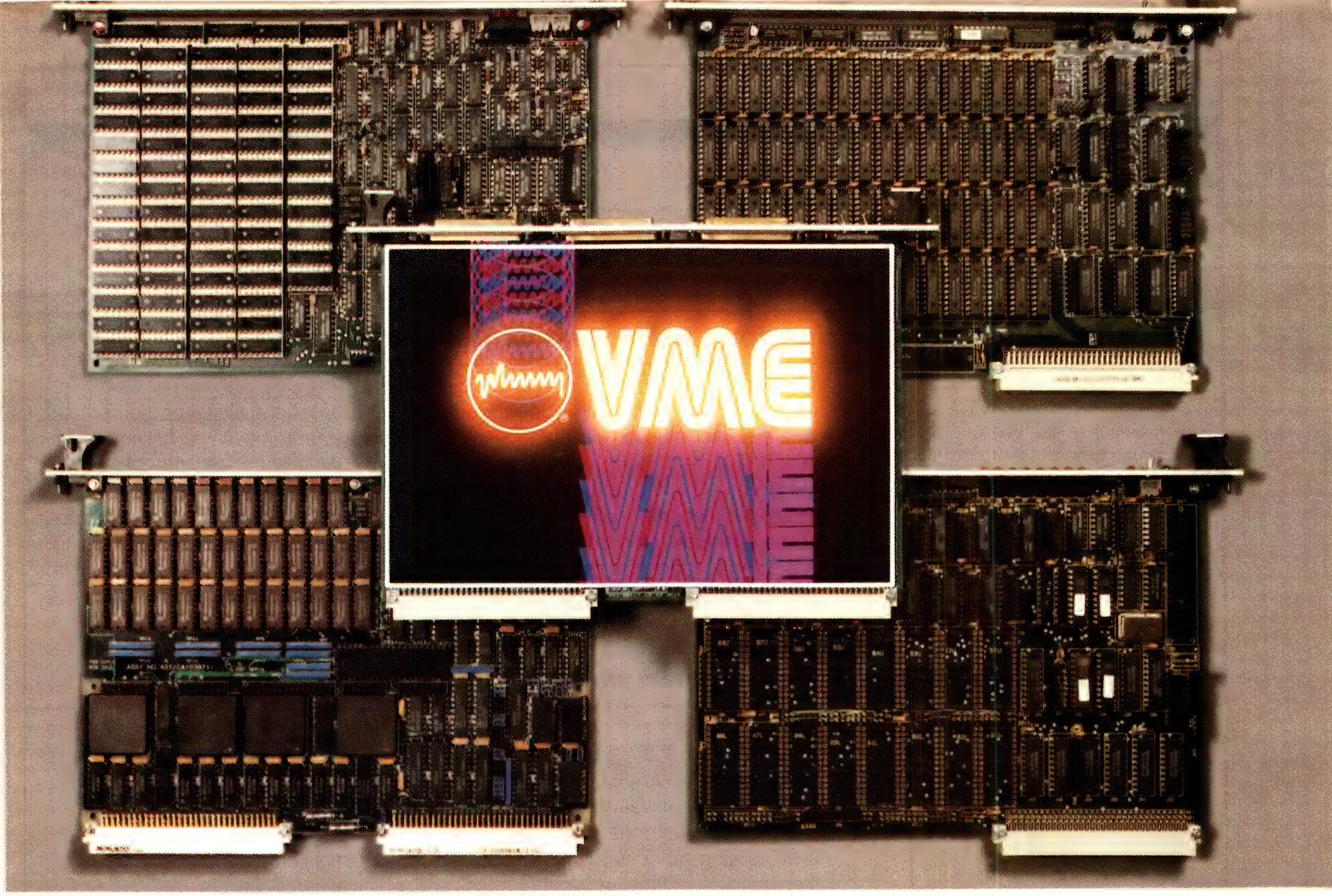

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512 Kbyte DRAM	PME 012D	●		8/16	190	300
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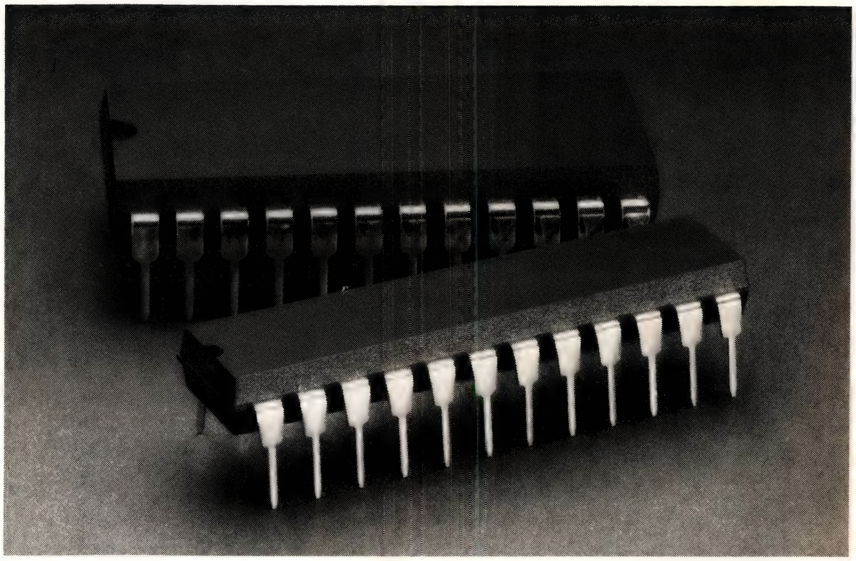

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Like the fact our PROMs not only read fast, they do it with less effort—half the power of bipolar PROMs.

Or the way you can order them with or without on-chip registers.

Then, of course, there's C²P.

You won't find it in the dictionary.

But you will find it in every Cypress Semiconductor PROM.

It's an innovative combination of our 1.2 micron CMOS process and proven floating-gate EPROM technology.

C²P cells make our speed/power ratio untouchable. And our reliability story one for the books.

For example, every high-performance PROM we ship is 100% write/read/retention tested.

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One that reads 400,000 times faster than Evelyn Wood. And remembers every word.

For some interesting reading of your own, we'll send you details on our high-performance PROM family. And our equally impressive SRAMs. Just write Cypress Semiconductor, 3901 North First Street, San Jose, California 95134. Or telephone (408) 943-2668.

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Circle 9 on reader service card

C&C
Computers and Communications

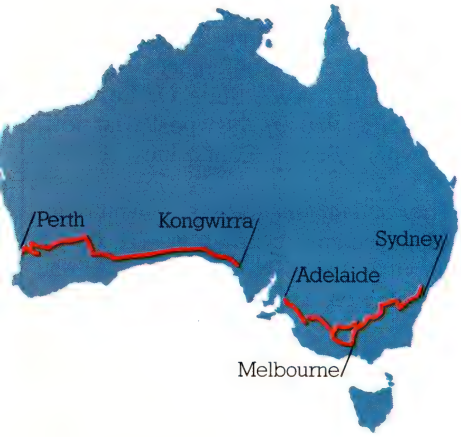
NUMBER 132

LARGE DIGITAL MICROWAVE LINK TO AUSTRALIA

NEC will supply Australia with a third large-capacity digital microwave system. Based on NEC's advanced 500-Series, it will span a total distance of 2,000km between Perth and Kongwirra in 52 hops.

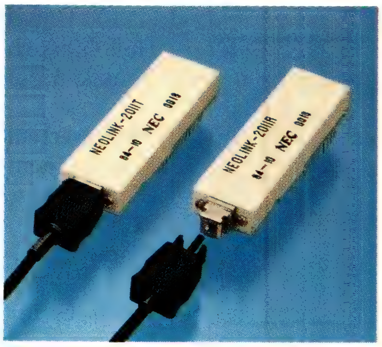
This new link will use NEC's 6.7GHz 140MB equipment with a capacity of 3,840 telephone channels, currently the largest available. The equipment is specially designed to operate in high temperatures, which top 55°C in the desert regions during the summer. Numerous advanced features, including adaptive and transversal equalizers and hitless switchover equipment, are incorporated to assure high speech quality.

The two previously supplied digital links are the 800km Sydney-Melbourne system and 650km Melbourne-Adelaide system. These also feature NEC's 500-Series 140MB equipment and accommodate 11,520 telephone channels.



NEOLINK™-2011 FOR HIGH-SPEED FIBER OPTIC LANs

Our new NEOLINK-2011, a pair of optical transmitter and receiver modules, enables the cost-efficient formation of reliable high-speed LANs without using LDs and APDs.



The NEOLINK-2011 combines a 1.3μm high-speed LED and PIN-PD. This ideal configuration takes maximum advantage of the low-loss, low-dispersion regions of graded index fibers.

The surface-emitting LED features 1.8ns rise and fall times and requires no thermoelectric cooling device. A newly-developed monolithic IC in the receiver incorporates AGC and line failure detection circuits and secures a 15 dB dynamic range. As a result, dependable high-speed digital transmission of up to 200Mb/s over a maximum distance of 3km is possible.

NEC's NEOLINK-2011 mates with graded index fibers of diverse core diameters. Interfacing with other systems is made easy by ECL level input/output and minimal restrictions on data formats.

The 9.5mm-high DIP design can be mounted directly on PC boards and runs on a −5.2V DC power supply. The built-in AGC eliminates circuit adjustments.

A low-profile, low-loss connector, with vibration-resistant lock, provides convenient snap-on connection.

NEC also supplies optical switches, couplers, fibers and all other components for LAN systems.

NECLINK is a trademark of NEC Corporation.

THAILAND SELECTS MORE NEAX61 DIGITAL SWITCHING SYSTEMS

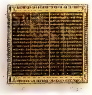
The Telephone Organization of Thailand (TOT) has again chosen the NEAX61 digital switching system. This time as the core of its fifth five-year telecommunications expansion project.

The contracts involve more than 870,000 subscriber lines (except for tandem switches) to expand the present digital network with new exchanges, including remote and cabin switches. When these new exchanges begin service, over two million subscriber lines will be served by NEC systems in Thailand.

The digital telephone network in Thailand features NCOM—NEC's Computerized Operation and Maintenance System. Incorporating the best of NEC's long experience and integrated computers and communications (C & C) technologies, NCOM provides comprehensive support using computers for the digital network—an important step towards the goal of ISDN.

NEC
NEC Corporation
Tokyo, Japan

Telex Shamrock cuts tape drive problems down to size.



(this size)

This gate array chip takes the place of two 10 x 14 PC boards of previous technology. But, small as it is (only 0.4″ square), it plays a large part in providing the huge boost in reliability and full performance GCR you'll get in the Shamrock 9250 tape subsystem.

Telex has combined over a decade of GCR advancements, the latest in vacuum column technology and reduced component count to make Shamrock the most reliable 50 ips tape subsystem in its class. Shamrock is so well designed, there are no planned service calls. Ever. Resident diagnostics and four microprocessors monitor and make any corrective adjustments necessary.

Reliability alone should give you all the reason you need to make Shamrock your first choice in tape subsystems. But Telex can give you a lot more reasons. Starting with the fact that Shamrock's unit price is less than half that of previous GCR subsystems. There's also Shamrock's full-size performance — faster access, greater storage efficiency, higher data reliability — all with reduced energy levels.

Size up Shamrock for yourself. Call the Telex OEM Sales Office nearest you or call Telex OEM Marketing at (918) 627-1111.

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JAPANESE FIRMS TAKE A SHINE TO MOCVD PROCESS

Sony's laser and Toshiba's LED are putting metal-organic chemical vapor deposition in technology mainstream

☐ *By Charles L. Cohen*

Tokyo

Metal-organic chemical-vapor-deposition technology is joining the mainstream of semiconductor production techniques as the most cost-effective way to produce optoelectronic devices on III-V compound semiconductor wafers. Along with the advantages of good control and high throughput, MOCVD techniques can process much larger wafers than can the currently popular liquid-phase epitaxial process. Though molecular-beam epitaxial technology boasts better control, its equipment cost is much higher and throughput is lower.

Sony Corp. is now using MOCVD for production of a new kind of tapered-stripe, visible-light laser with an output of 5 mW at 780 nm. Standard devices will be used in compact-disk digital audio players, while selected low-noise devices will be used for laser video-disk players.

Toshiba Corp. will use MOCVD for a light-emitting diode with an output of 150 μW at 890 nm. These devices, which will be available as samples in the middle of 1985 and in volume at the end of the year, are designed for short-haul optical-fiber communications links with bandwidths of up to 60 MHz.

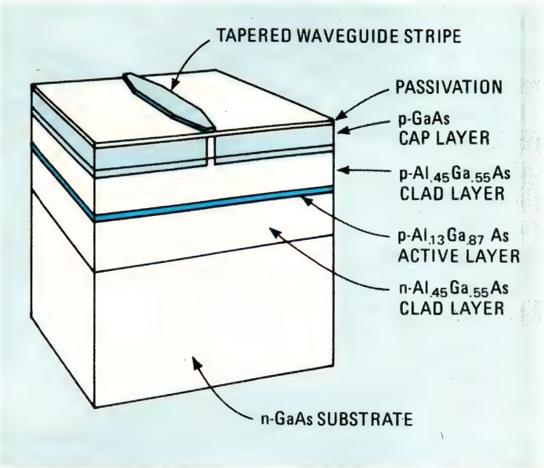
For multimode. Aside from being manufactured with MOCVD technolgy, Sony's new laser is designed for multimode rather than for the single-mode operation common in communications applications. Multimode laser operation is preferable for player applications because it is not plagued by mode hopping—which generates noise bursts—to which single mode lasers are prone.

Seiichi Watanabe, deputy general manager of the Research Department in the Semiconductor Group, says that a gain waveguide configuration was selected rather than the usual refraction waveguide to give multimode operation. In a gain guide, the cavity is defined by that region of the laser diode in which current density is sufficiently high to produce the gain necessary for laser operation. In the more usual refraction guide, the cavity is defined by an increase in index of refraction similar to the interface between the core and the clad of an optical fiber.

A disadvantage of the gain guide when it is fabricated with fine geometry for small spot size is that the far-field pattern of the beam tends to be hollow—that is, the intensity is weak in the center and stronger toward the edges. Watanabe says that Sony engineers compensated for this by designing a guide that is 8 μm wide in the center and tapers to 3 μm at its ends. The wavefront of the beam in the tapered section remains substantially the same as it was in the wider center section and the laser generates a properly shaped beam.

Fabrication of the device starts with an n-type gallium arsenide substrate (see figure) on which are grown in sequence by MOCVD an n-type aluminum GaAs clad layer, a p-type AlGaAs active layer, a p-type AlGaAs clad layer, and then a p-type GaAs cap layer. The active layer is only 800 Å thick. In the active layer, 13% of the gallium is replaced by aluminum, but in the clad layer, the proportion of aluminum is 45%. This gives the clad layers a higher index of refraction than the active layer and confines the laser beam vertically.

A tapered gold stripe 8 μm wide in the middle and 3 μm wide at the ends is fabricated on top of the cap layer to define the laser cavity horizontally. Proton radiation that completely penetrates the cap layer and part of the way into the


TAPERED WAVEGUIDE STRIPE
PASSIVATION
p-GaAs CAP LAYER
$\text{p-Al}_{.45}\text{Ga}_{.55}\text{As}$ CLAD LAYER
$\text{p-Al}_{.13}\text{Ga}_{.87}\text{As}$ ACTIVE LAYER
$\text{n-Al}_{.45}\text{Ga}_{.55}\text{As}$ CLAD LAYER
n-GaAs SUBSTRATE

Simple fix. Compensating for the tendency of the far-field pattern of a laser to be hollow, Sony engineers designed a tapered guide. The wavefront of the beam in the tapered section then remains essentially the same, and the laser generates a properly shaped pattern.

tors has proved troublesome to many equipment firms and tends to dilute profit margins to the point that motivation suffers, he explains.

Perhaps no product area has been harder hit than disk drives. "The environment has changed, no question about it," confirms William J. Schroeder, president of Priam Corp. What this means to the San Jose, Calif., company, for one, is that product plans must be scrutinized more rigorously. "In the old days, we'd do a product and it would succeed. Now, the odds are against that happening," he says.

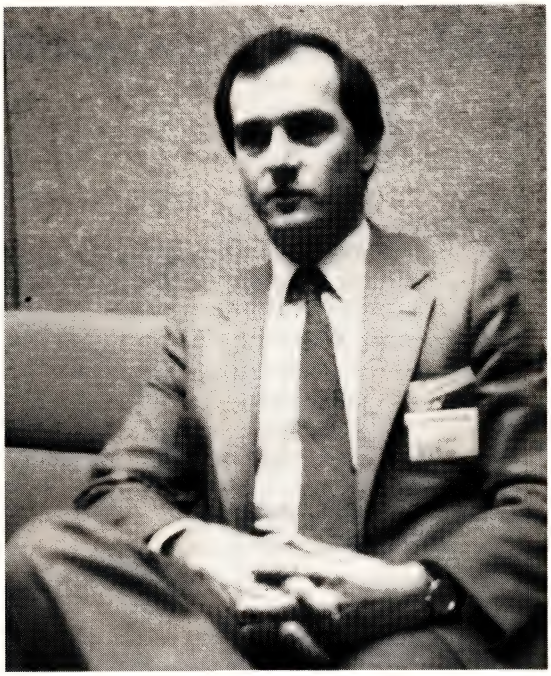
Specifically, Priam is de-emphasizing drives in areas where competition seems heavy (for example, at the 80-megabyte level) and leapfrogging to 5¼-in. drives sized to 153 Mb, where an early advantage might be gained by delivering.

Other makers of high-performance equipment have reported continuing growth. "The OEM market is picking up strongly in half-height disk drives," said Ron Schlitkus, marketing director at Microscience International Corp., Mountain View, Calif. James Adkisson, executive vice president of Vertex Peripherals Corp., San Jose, said demand is also strong for high-capacity drives in multitasking, multiuser systems. "The volume, though, is still only one tenth of the low-end drives," he added. (Priam and Vertex merged shortly after Comdex; see News Briefs, p. 22.)

Survivors. "The high end will be the healthy part of the disk-drive business," agreed Allan R. Abbott, president of Spectra Logic Corp., Sunnyvale, Calif. Abbott's firm, which makes controllers, may be acquired by Cypher Data Products Inc., of San Diego, which makes tape and cartridge drives. Together, the two firms plan to make an intelligent subsystem that could plug directly into a computer bus. "We see additional functionality as a way of surviving," Abbott said.

That integration is also under way at Quantum Corp., Milpitas, Calif. Quantum has developed its own controller capability and next year will market a drive with a built-in controller and a link to the intelligent Small Computer Systems Interface.

Rolf Brauchler, Quantum's marketing director, seemed unworried by a shakeout. "There is an industry-wide slowdown and consolidation going on," he said. "We won't stay totally free of it, but it's not so bad."



Unworried. "There is an industry-wide slowdown and consolidation going on," says Quantum Corp.'s Rolf Brauchler, which he labeled as "not so bad."

Among computer companies at the show, Sperry Corp. unveiled one of the most ambitious undertakings in its history: nothing less than a line from microcomputers to mainframes that will support AT&T Bell Laboratories' Unix operating system. These include the 5000 series of multiuser microcomputers and 7000/40 superminicomputers, which join Sperry's personal computer and 1100 series mainframes.

The introduction was years in the planning, and carrying it off involves changing a "stodgy, introspective mainframe company into one with a new culture and vitality," said James B. Aldrich, vice president of product strategy and market development for the Information Systems Group, Blue Bell, Pa. Sperry has, among other things, trained a direct-sales staff of about 1,700.

How to respond. Not all firms have the latitude to turn their objectives around during a shakeout, because product-development cycles can require years. But that does not preclude responding anyway, said Howard F. Earhart, president of Amcodyne Inc., Longmont, Colo., which is a classic niche company that targets 8-in. fixed and removable disk drives. "In the shakeout, we still do the same thing, but in a more intense, concentrated fashion," he noted.

Amcodyne, therefore, has expanded its line by adding the Arapahoe 7110/7110S, which features a 53.9-Mb capacity in each fixed disk and a removable cartridge. It proved popular enough to snag four major computer firms as customers, Earhart noted. His firm also is representative of private companies so far denied the financing from public stock offerings. It recently completed its fourth round of venture-capital financing, a number unheard of until the recent downswing.

While software firms and software products continue to have their problems satisfying more demanding customers, the vice president of marketing at a major software company, Digital Research Inc., Pacific Grove, Calif., believed the worst times are over. "It is now clear what both IBM and Apple are doing, and that stabilizes the market," said Fred G. Cutler.

Demystified. Digital Research's own conclusion, after "lots of soul searching four months ago," is that the market "is still crying for user-familiar computers." So the firm has put renewed emphasis on going after this business, of which only about 20% has been satisfied. One result is its GEM desktop application package, which translates a microcomputer screen based on a disk operating system into a graphics environment for simple manipulation of images. Among other things, it "demystifies" microcomputers, the company says.

One expert, Robert R. Ackerman Jr. of Unisoft Systems Corp., Berkeley, Calif., a specialist in adapting Unix, suggested that the development of software for vertical markets would be fruitful. "Relatively few people use software tools," he said. "But with current 32-bit chips, for the first time users can have the power of a VAX 780 on a desktop. There are a lot of applications that people couldn't afford at $500,000

INDUSTRY TO FEDS: GET BACK DOWN TO EARTH

Washington, D.C.—The National Weather Service would like to know tomorrow's weather today. The National Aeronautics and Space Administration wants to replace wind-tunnel tests with computer models that simulate the drag and lift of aircraft. The Department of Energy wants to reduce the number of underground firings it takes to verify new designs of nuclear weapons.

Achieving those goals, however, requires supercomputers to be 1,000 times faster than they are now. "We're talking about solving equations with millions of grid points. For that we could easily make use of machines sustaining speeds of one teraflops [1 trillion floating-point operations per second] and we'd like to be there by the mid-1990s," declares Robert A. Graves, assistant director of NASA's Aerodynamics Division.

Still, many in the industry question whether Washington's effort is enough, and more important, headed in the right technical direction.

The response. Two years ago, federal research and development funding for high-speed computers came to a mere $17 million. The Department of Defense accounted for 70.5% of the expenditures, with the rest split between DOE and NASA. The National Science Foundation did not fund supercomputer work until this year, when it spent $6 million for supercomputer time.

Then came reports suggesting that the Japanese could soon overtake the U.S. leadership position in computers—throwing the government into a state of near paranoia. Although the fear has since been abated by evidence that Japanese supercomputers are at best on par with U.S. models, the end result was positive for the industry: a dramatic rise in spending (to over $326 million) for both supercomputer R&D and procurement. For example, in its 1985 budget, the NSF is using $40 million to launch a four-year program to build 10 university-based supercomputer centers linked by a communications network. And NASA has been given the go-ahead to spend over $100 million over the next five years for the newest available supercomputers.

But by far the most ambitious and important thrust is the Defense Advanced Research Projects Agency's $600 million Strategic Computing Initiative. The SCI "is the only one focusing on machine intelligence and thousandfold to ten thousandfold speed improvement over existing computers," claims Robert Khan, director of Darpa's Information Processing Techniques Office. In a few weeks, Darpa will award contracts to as many as eight university teams for the prototype development of a general-pur-pose parallel architecture that could have thousands of processors.

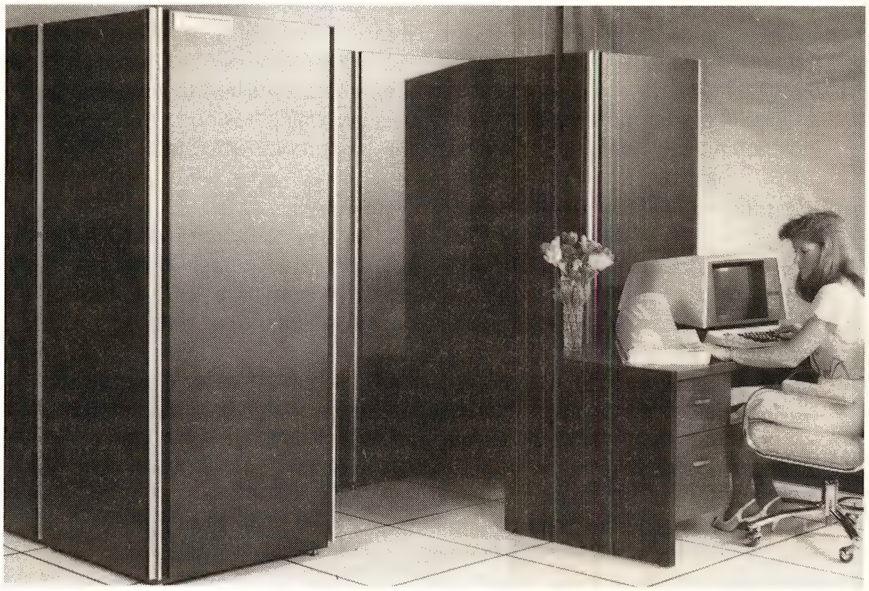
Technical feasibility. The massively parallel approach is the only way to break the speed-of-light stranglehold on computer speed, Khan and other top science advisers argue. But there are those who think Darpa is leading the research community down a blind alley.

"Frankly, I'm not convinced that the government's push for massive parallelism won't produce more elaborately conceived grant proposals than viable machines," says Norman Weizer, a senior consultant at Arthur D. Little Inc., Cambridge, Mass. In Weizer's opinion, there is little evidence that multiprocessor systems will work. He expects them to be dragged down by the problem of writing new algorithms to perform in parallel.

"Improved computer-aided design and manufacturing stations, algorithms to speed up the supercomputer applications, and even standards to measure and compare their performance, would be far more useful both to supercomputer users and manufacturers, and have a greater positive impact on the economy."

Others criticize the Darpa effort on the grounds that even should it succeed, the market for lightning-fast computers is too small to convince any of the manufacturers to build them. A year ago, for instance, NASA went to Control Data Corp., Minneapolis, and offered $50 million on the spot if the firm would undertake the design of a massively parallel machine. CDC refused because the payoff was judged too small, relates Earl Dowdy, an analyst tracking the issue for the Office of Technology Assessment.

At a time when government users



At work for the government. Denelcor is using its HEP 1000 to work on federally funded supercomputer programs, and is bidding on additional contracts.

ry which is most important." The multiprocessor architectures built for Darpa "will probably work for its problems but not be relevant to the variety of tasks supercomputers need to handle," he contends.

Echoing Cray's view, Thorndike thinks the government should stress buying supercomputers. But in sharp divergence with Cray, he wants Washington to go as far as to define the performance parameters of future machines and then guarantee to purchase the fruits of industry's labor. Japan has shown that government can stimulate competition and technology by sharing development risks, he argues. "Currently, though, [Washington's] attitude is, 'You build it, we'll test it, and then maybe we will buy it,' " he says.

In agreement is Denelcor Inc., Aurora, Colo., the only supercomputer vendor with an SCI contract and plans to bid on others. The firm is a consultant to Martin Marietta Denver Aerospace, which has been selected as the systems integrator for one of the SCI applications, an autonomous land vehicle [*Electronics-Week*, Nov. 5, 1984, p. 24].

Need more. Ron Ames, a Denelcor vice president, says the vehicle's artificial-intelligence functions require a lot more power than can be delivered by today's vector supercomputers. But scalar, highly parallel machines, "lend themselves better to image processing and AI than to traditional supercomputer jobs," he admits. Yet the day is coming when parallel processing will dominate number crunching, too, he says.

Though both Cray and ETA question government sponsorship of research on massively parallel processing (no useful architecture has ever come out of a university, notes Weizer), they are delighted about one new development: After many years of neglect, the NSF has finally gotten into the act. It is putting more computers into universities, which will mean greater exposure for the technology, and ultimately bigger markets. Concurrently, greater familiarity should encourage more engineers to adopt supercomputing as a vocation. According to industry consensus, the expanding pool of supercomputing talent could be the biggest payoff to come from the government's efforts. —**Karen Berney**

ICL MAKES BIG MOVE IN SMALL-OFFICE GEAR

London—Britain's largest computer company, International Computers Ltd. plc, is now bidding for a spot in the office with a powerful work station that combines a personal computer, smart telephone, voice synthesizer, and modem in a single box.

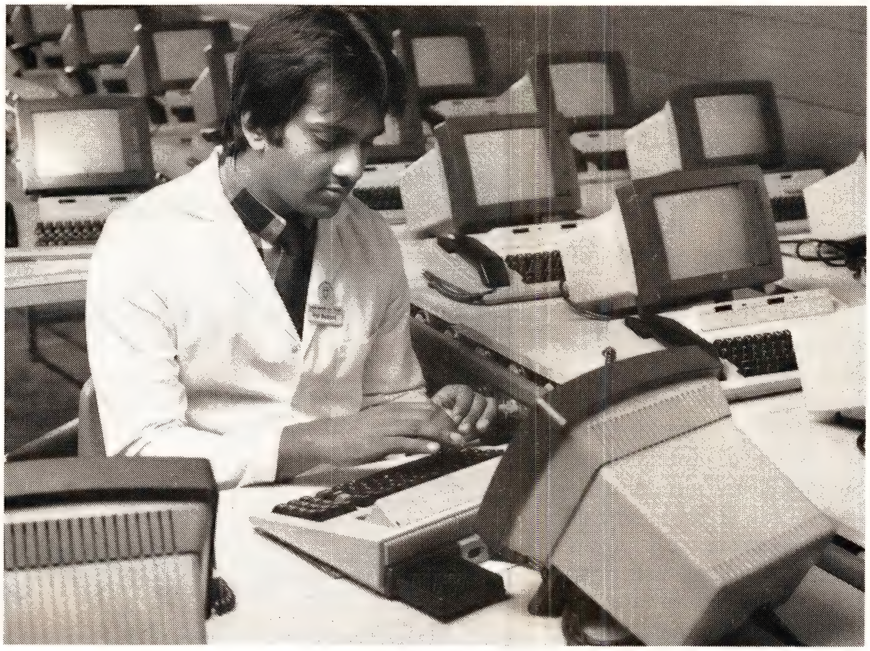
The One Per Desk, or OPD, is designed for the busy middle manager with no secretary and little or no administrative support. Convinced there is a big market for the machine, ICL has ticketed it at an aggressive $1,500 and will crank it out at a spanking-new automated assembly line in Letchworth, Hertfordshire. The $12 million facility can produce up to 100,000 units a year.

OPD's development has had top company priority and is one of three major projects—the other two are mainframes that are expected shortly—set up by chief executive officer Robb Wilmot when he was tapped to rescue ICL three years ago. At the time, ICL had a dangerous debt burden and was losing money heavily. "With OPD, we intend to be a major competitor in the convergence of voice and data terminals," says managing director Peter Bonfield.

So far, only a few companies—among them Mitel Corp., Kanata, Ont., Canada—have put such a product on the market. IBM Corp., Armonk, N.Y., and AT&T Co., New York, have yet to make a play. Still, ICL expects that by the end of the decade, 60% of office work stations will have voice/data facilities.

Cracking the market. In the UK alone, the firm has identified a market for 600,000 terminals over the next four to five years. Few in the business quarrel with that estimate, but some wonder if the ICL machine will be the one to crack it. "Where is the Sinclair flat-screen?" asks Neil Barton, an analyst at Henry Cooke, Lumsden and Co., a London stock broker. "Without it, the OPD's footprint is just too big."

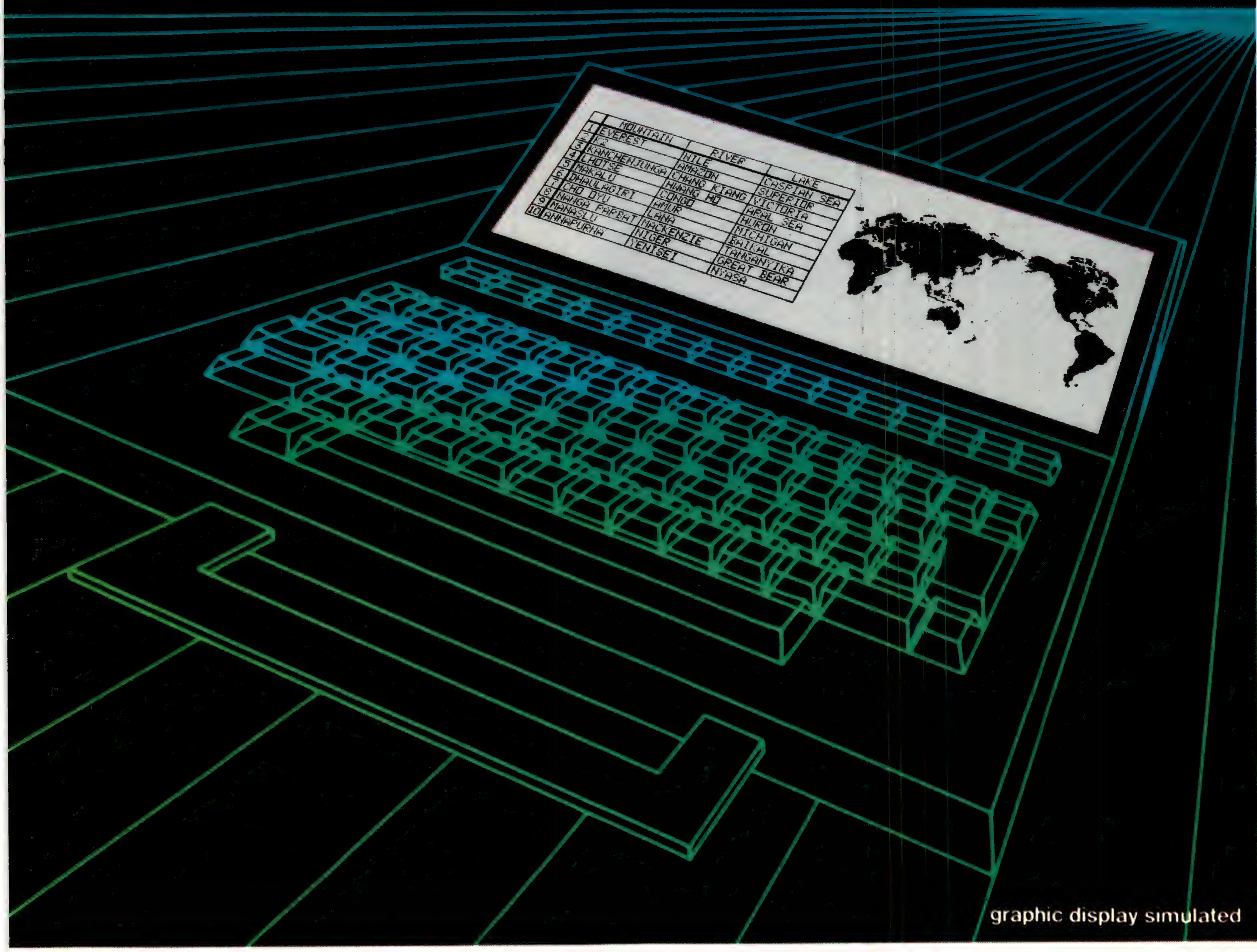
For its first marketing push, ICL is targeting large original-equipment manufacturers, European telephone administrations, and suppliers of val-



Getting ready. Anticipating a vast market for integrated office equipment, ICL plc is planning to produce up to 100,000 of its desktop units per year.

SHARP'S BIG LCD'S FOR SMALL PLACES

640 × 200 Full Dot Matrix LCD



graphic display simulated

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GRAPHIC LCD UNIT **LM64004G**

Graphic display type

Model No.	Display Format (dot × dot)	External Dimensions W × H × D (mm)	Controller LSI Part Number
LM24002G	240 × 64	260 × 80 × 14	LR3691
LM24003G	240 × 128	241 × 125.3 × 14	LR3691
LM48003G	480 × 64	290 × 70 × 12	LR3691
LM48004G	480 × 32	290 × 52 × 12	LR3691
LM48008G	480 × 128	261 × 96 × 12	LR3691
LM48010G	480 × 200	261 × 130 × 12	LR3691
LM64004G	640 × 200	272 × 109 × 12	LR3692*

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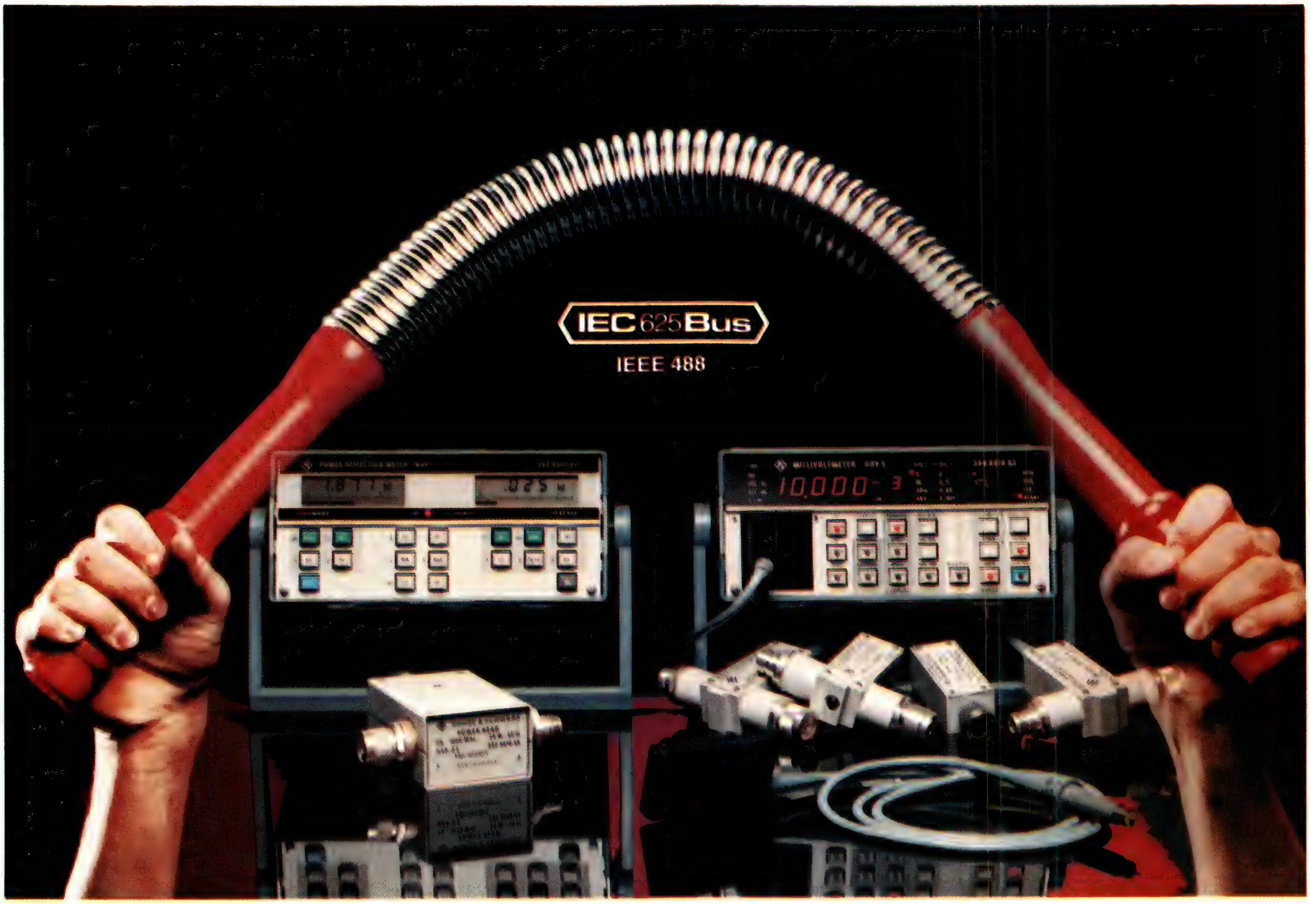

Power Reflection Meter NAP

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Power:	20 mW to 1.1 kW
SWR:	1.03 to 99

- Detached power heads with negligible insertion loss
- Two displays for incident and reflected power
- More than 500 hours of operation from batteries due to use of CMOS microprocessors
- Computation of measurement parameters based on inherent intelligence

RF Millivoltmeter URV 5

Frequency:	9 kHz to 18 GHz and DC
Voltage:	200 μV to 1000 V
Power:	1 nW to 20 kW
Level:	−60 dBm to +73 dBm

- Unsurpassed accuracy due to microprocessor-controlled error correction: error < 1 %
- Frequency-dependent calibration factors are automatically taken into account
- Two identical measuring channels
- Great choice of intelligent measuring heads with test-parameter storage (R&S patent)

Please ask for the data sheets NAP and URV 5

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THE SHOW MUST GO ON—ON THE DESK

San Antonio, Texas—Video-compression algorithms have long been used to reduce the amount of data and the costs needed to transmit images over long distances. Now, dedicated hardware, circuit integration, and hard-disk-based personal computers are squeezing compression processing into desktop video-conferencing packages slated to hit the market by early 1985.

The effort to shrink the size of picture-compression systems is part of a move to take some of the emerging video-communications business out of expensive, specially equipped conference rooms and place it on the professional's desk. Market estimates for U.S. video-conferencing services and hardware swing across a wide spectrum, ranging from $500 million to $1 billion by 1990.

Growth to be slow. The upcoming availability of switched 56-kb/s digital phone lines is expected to bolster the high-end estimates. However, video conferencing will continue at slower growth rates than initially thought, according to Lou Verchot, a senior consultant who keeps his eye on transmission technology at Eastern Management Group, Morris Plains, N.J.

In 1984, Eastern Management estimates that video conferencing reached $109 million in the U.S.; by the end of the decade, it will be a $478 million business. "It will take off around 1988, when several things happen, including availability of lightwave [fiber-optics] networks," Verchot maintains.

Hoping to ring up big sales in video telecom next year is Photophone Inc., a San Antonio startup with its sights on marketing a complete freeze-frame system that transmits monochrome 320-by-240-pixel images over standard telephone lines in as little as 8 seconds. The firm claims the unit is the first to bundle all the imaging and transmission elements for video conferencing in a cabinet small enough to fit on a desk.

Priced at $9,995, the Photophone system is built around five printed-circuit boards using off-the-shelf integrated circuits and field-programmable logic arrays. At its heart is a video-compression engine, based on a speedy bipolar 16-bit microprocessor from Advanced Micro Devices Inc. in Sunnyvale, Calif.

The unit also contains a system control processor, audio board, analog-video module, and digital video card. The Photophone is designed to transmit the monochrome images in five speeds, ranging from 8 to 30 seconds—with deteriorating picture quality at higher speeds. The Photophone will automatically adjust its transmission rates from 9.6 kb/s to one of the slower speeds if it encounters poor line quality.

"We intend to provide a Volkswagen type of product that is portable—meaning it makes video conferencing possible over a single standard phone line and is easy to use," states Gerard Cullen, a marketing vice president at Photophone.

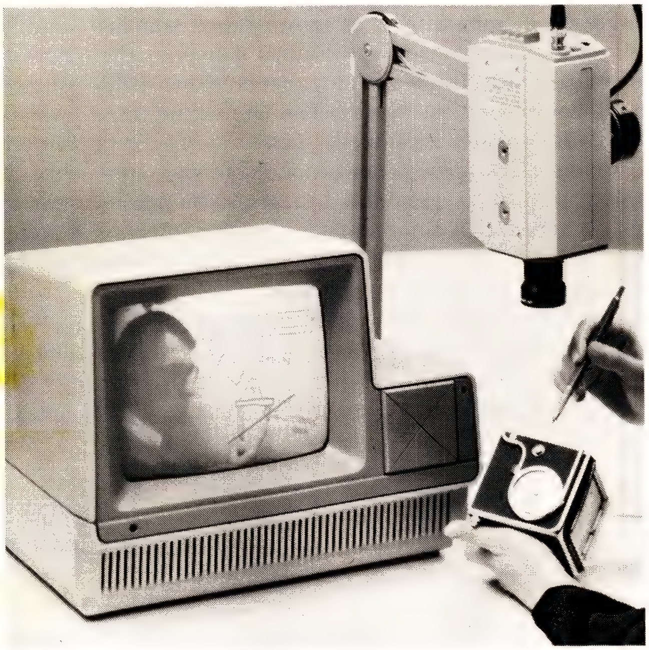
The unit bundles a 9-in. monochrome screen, telephone interface circuitry, and digital video-compression hardware inside a 28-lb desktop unit. It plugs directly into a standard phone jack and interrupts voice communications only when images are being sent. Voice communications are conducted through a standard phone, which plugs into the back of the video system.

"We are using standard compression techniques in theory, but I have also got to say that implementation of those techniques is where the rubber meets the road," says Cullen. For proprietary reasons, he refuses to discuss the methods Photophone has devised to best apply its codec algorithms.

Lower parts count. Photophone plans to further reduce the chip-parts count in future generations of desktop systems by implementing hardware and software in dedicated semicustom logic arrays as well as full-custom large-scale integrated circuits. Volume deliveries of the first system will start in the first quarter.

Pressing on the digital-transmission side of personal video teleconferencing is Widcom Inc., of Campbell, Calif., which plans to begin deliveries of a full-color desktop picture telephone in January. Priced at $17,500, Widcom's Personal Videoconferencing System (PVS) consists of a desktop console with speaker, color camera and two color monitors, a copy stand for graphics, and a keyboard-drawing pad.

Using Widcom's 56-kb/s coder-decoder system, the unit can transmit long distance directly over soon-to-be-available



Small and simple. The Photophone is a self-contained video-transmission system with data-compression smarts built in. To employ its black and white, freeze-frame capability, all a user needs is a telephone jack and access to standard phone lines.

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Circle 33 on reader service card

A sleek picture. Hitachi's electronic camera, printer, and floppy unit with disk will be able to interface with conventional VCRs, TVs, modems, and personal computers.

supply electric power. Both NTSC and red-green-blue output signals are provided. Playback from a disk drive, however, is more convenient.

The camera's disk-pack capacity is 50 single-field photos with a horizontal resolution of 350 lines taken at shutter speeds of 1 to 1/1,000 s. But a trade-off is possible. If the fastest shutter speed is limited to 1/30 s, the camera can be designed to take 25 full frames of two fields each. Michio Masuda, a senior researcher at Hitachi's Consumer Products Research Center in Yokohama, says that Hitachi will incorporate a full-frame mode for the 1/30-s shutter speed only and will interpolate the missing field at other speeds.

Two heads. Both the camera and the disk drive use an in-line head assembly with two thin-film heads for adjacent tracks. Gaps in the heads are skewed from the perpendicular by azimuth angles that have the same magnitude but opposite sense. This reduces crosstalk between adjacent tracks in the same manner that azimuth recording on video tape reduces crosstalk. Fabrication of the individual heads for VCRs is simpler, though, because the heads for adjacent tracks are spaced opposite each other on a rotating assembly.

Hitachi's disk-drive peripheral can record single-field and full-frame pictures in any combination. It can also record and play back identification information including track or field number, date, time, and so on. Both NTSC and RGB output signals are available.

The color printer is a conventional thermal-transfer type using dyes that evaporate from a carrier sheet and form a molecular bond with a plastic-coated printing paper. Cartridges for printout contain 50 repeating trios of yellow, cyan, and magenta carrier sheets. Kentaro Hanma, also a senior researcher at Hitachi's Consumer Products Research Center, explains that printer parameters were designed to eliminate scan lines in order to simulate a conventional photographic image.

Interpolated lines are used to simulate a full frame when printing recordings of a single field. Full-frame recordings can also be printed out. The thermal head assembly in the printer contains 512 separate elements and prints successive lines at intervals of 1/6 mm. Because the interline spacing is small and there is some spreading of the dyes between the lines, individual lines are not discernible.

–Charles L. Cohen

MEDICAL

HEARING AID TURNS SOUNDS INTO VIBRATIONS ON WRIST

Erlangen, West Germany—Some relief is in sight for people whose hearing is so poor that conventional hearing aids are of limited or no value.

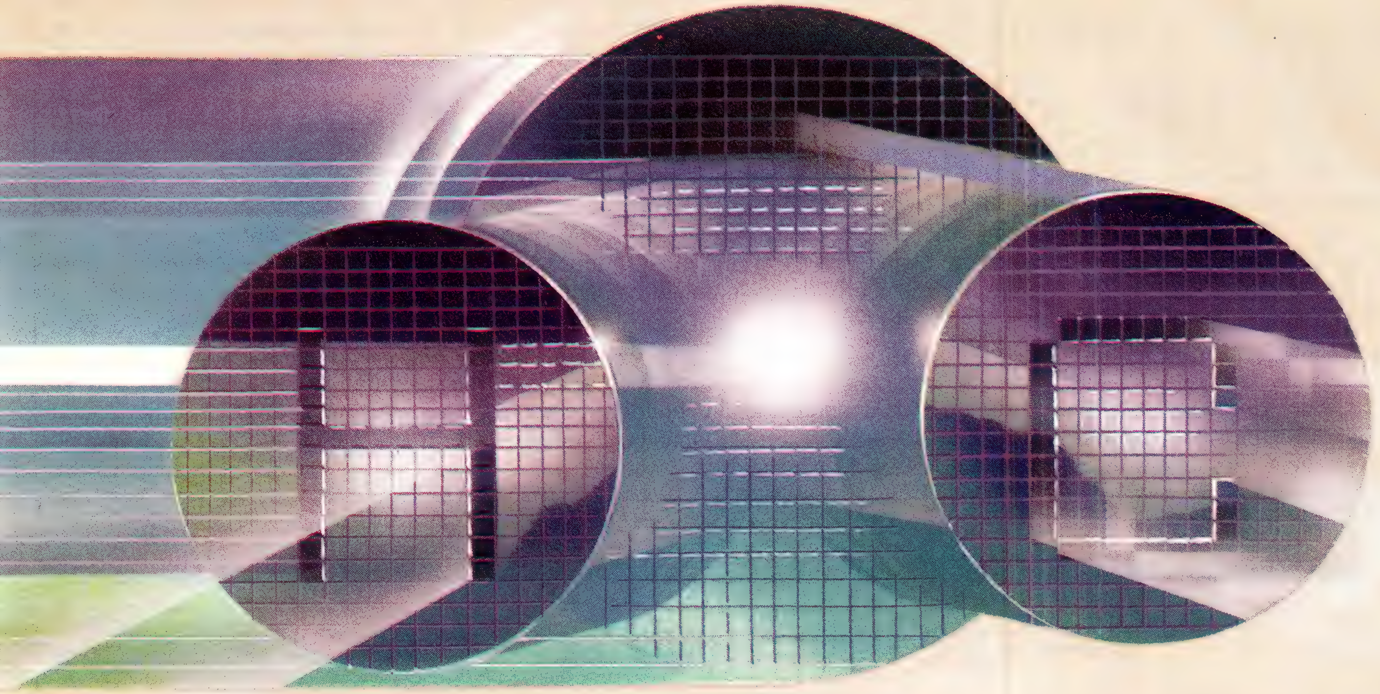
The relief will come in the form of an electronic, vibration-based device soon to be marketed by the Medical Electronics Group of Siemens AG. Called the Mini-Fonator, the new aid is meant to supplement communications by sign language and lip reading. To do so, it electronically processes sounds and then transforms them into vibrations that it applies to the skin of the wearer.

In operation, sound is picked up by a small microphone that clips to the user's lapel. These signals are fed to an amplifier held in a pocket or attached to a belt. After amplification, the signals go to a vibrator, which resembles a watch and is worn on the wrist. There, in accordance with the sound frequencies, the signals produce mechanical vibrations that the person senses as tactile responses on the skin. In this way, the person can make out various sounds.

With the Mini-Fonator, the deaf person can distinguish between the consonants N and T, for example, which can hardly be done by lip reading. Furthermore, the device gives the user the sense of speech rhythm, which is important to speech and its comprehension.

Foreign aids. Siemens is not alone in this market. A similar device is being developed in Sweden, but it is based on fixed-frequency-oscillator principles. In the U.S., several institutes and private companies have launched vibration-based aids as experimental devices, but these have not yet gone into industrial production, according to Friedrich Harless, who heads the lab in Erlangen that developed the Mini-Fonator.

The device's vibration principles work only for sounds at frequencies below 1 kHz. Above that value, the frequencies are too high to be changed into vibrations that the person can sense, says Harless. As a



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The 8088-2 is a high-volume professional product. Its high operating frequency (8 MHz) and impressive addressing capabilities put it a big step in front of its competitors. This can now be considered the industry standard for up-market PC's (8 MHz) as well as real-time data processing for process control applications.

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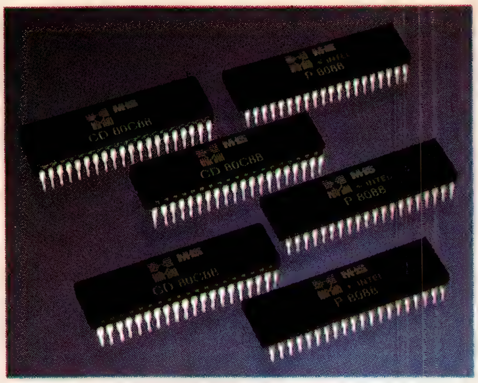

High reliability applications calling for low power consumption.
The exceptional performance of the 80C88 makes it a prime candidate for the professional EDP market (portables), military and aerospace applications (on-board computers, fire control systems, field test systems).

8088 charateristics

8088/5 and 8 MHz	Temperature	Packaging
	0 to 70 deg C	DIL, PLASTIC, CERDIP
	-40 to +85 deg C	DIL, PLASTIC, CERDIP
	-55 to +125 deg C	DIL, CERDIP

80C88 charateristics

80C88/5 MHz	Temperature	Packaging
	0 to 70 deg C	DIL, PLASTIC, CERDIP *LCC, PLASTIC, CERDIP
	-40 to +85 deg C	DIL, PLASTIC, CERDIP *LCC, PLASTIC, CERDIP
	−55 to +125 deg C	DIL, CERDIP *LCC, CERAMIC

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Circle 94 on reader service card

tems include the Live Image Publishing System offered by Texet Corp., Arlington, Mass., which can interface to a computer-aided design system, and starts at $65,000. Four-color photos can be added by a color printer if windows have been left.

Interleaf Inc., Cambridge, offers a model that includes a 32-bit 68010-based work station, graphics controller, integrated software, and laser printer for $65,800. "A small firm producing 100 pages a month could benefit from a CEP [corporate electronic-publishing system]," says David Boucher, Interleaf president.

Wright believes the startups will be aided in opening the market by such big firms as Eastman Kodak, Wang Laboratories, and Compugraphic Corp., which make various pieces of equipment for electronic-publishing systems. These large firms will use their resources to educate customers and afterward convince them to buy systems.

CORPORATE ELECTRONIC PUBLISHING SYSTEM SUPPLIERS

Company	Founded	Type of product
Adobe Software	1982	raster image processor
American Printing Technologies	1983	total CEPS
Applix Inc.	1983	text and graphics creation
Bedford Computer	1976	total CEPS
Caddex	1982	total CEPS
Camex	1976	CEPS graphics and pagination
Concept Technologies	1982	personal computer CEPS
Datacopy	1979	image scanning and editing
Data Recording Systems	1983	output device
Demonics	1982	image scanning and editing
Ikan		artist pagination work station
Imagitex	1982	image scanning and processing
Impres	1981	line art editing
Intercad		total CEPS
Interleaf	1981	office document CEPS
Intran	1971	image scanning editing and laser printing
Mindset	1983	personal graphics and CEPS
Penta	1976	total CEPS
Studio Software	1982	personal publishing CEPS
Quality Micro Systems	1977	intelligent laser printing
Qubix	1983	electronic-illustration CEPS
Raster Tech	1982	raster image processor
Scitex	1971	CEPS color-image processing
TYX	1982	total CEPS
Texet	1982	total CEPS
Via Video	1981	electronic illustration
Viewtech	1983	total CEPS
Westminster Software	1983	PC composition software
Xenotron	1977	CEPS graphics and pagination
Xyvision	1982	total CEPS

SOURCE: INTERCONSULT INC., CAMBRIDGE, MASS.

Key factors aiding the market's growth include the falling prices of processors, hard-disk drives, and laser printers, as well as the various types of software required. "To develop software for typesetting is deceivingly complex," says Daniel Kennedy, president of Texet.

Adding dots. Typical laser units such as those offered by Quality Micro Systems, Mobile, Ala., are now achieving 300 dots/in. But soon they will accomplish 600 to 800 dots/in.—just 200 dots/in. less than many typesetters. "Laser printers will eventually become indistinct from typesetters," says Zadow. A 600-dot/in. laser printer will be announced in April by Data Recording Systems, a 1½-year-old firm located in Melville, N.Y., according to its president, David R. Spencer.

Advances in digital techniques have also contributed to the market's growth. Line drawings take 250 times more storage than text on the average, Wright points out. In addition, coding has been greatly simplified. "We set up a document style for each publication that specifies the heads and typeface. Coding is 10 times easier," says Texet's Kennedy.

But the major driving force behind the market, analysts and vendors agree, is the time reduction in getting printed material to customers. Such steps as typographic makeup, hand drawing of layouts, paste-up of typeset copy, and correction of color separaton films, along with the labor involved, can be eliminated.

Over $150 million in venture capital has been invested for products that will come to market within 12 to 18 months, InterConsult studies show. Backers of Data Recording Systems include Merrill Lynch Venture Co., Citicorp Venture Capital, and W.R. Grace and Co. "The startups don't have competition from entrenched suppliers. As in the CAD industry, small companies did a lot, and big companies came in later," says Frederick Bamber, general partner with Applied Technology Partners L.P., a venture capital firm that has invested in Interleaf and Imagen. On the same note, Data Recording Systems' Spencer doesn't believe the demand is big enough yet for corporations like Xerox or Canon to enter. "But it's plenty for a startup."

Squeeze coming. Paralleling what has happened in the shaping up of many other markets, analysts and vendors believe some firms will drop out or merge along the way. "Some of the companies are likely to get squeezed out in a year or so," says Zadow. Wright expects half of the 25 to be merged or acquired within 15 months.

Meanwhile, the proposed $4 million system at Digital Equipment Corp., which is expected to be in operation within nine months, will communicate worldwide to its offices, and will do everything from internal support documents and promotional materials to the four-color annual report. Assigned to the project 2½ years ago, Philip Francis, production services manager for the Corporate Communications Group at DEC, says the system will use a VAX system for the data base; processing gear offered by Texet; DEC videotext and nonimpact printing technology. **–Steve Haggerty**

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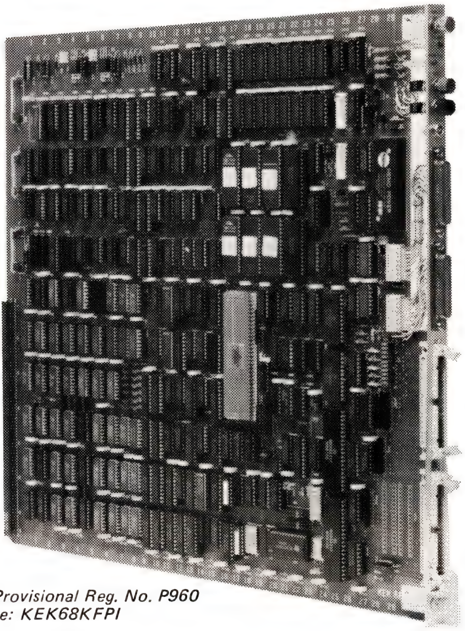

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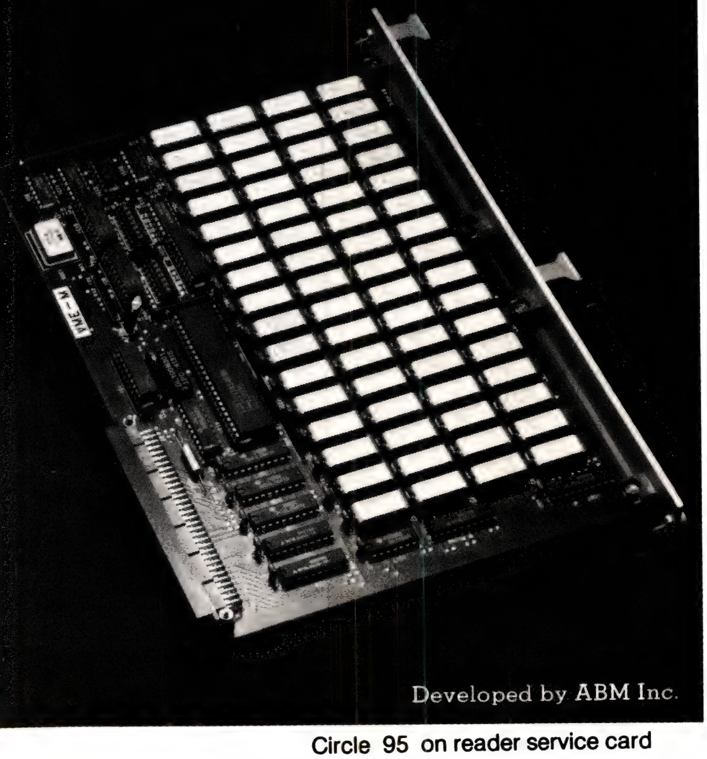

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STERN SPELLS EUROPE'S FUTURE O-S-I, NOT I-B-M

Bullish. As part of a strategy to put Bull back on its feet, Jacques Stern has led a European movement to get OSI standards adopted. Eleven other firms have followed.

Paris

For anyone with doubts about whether the world's data-processing industry will ever be blessed with common standards, a chat with Jacques Stern should be obligatory. Stern was entrusted by the French Socialist government in 1982—after execution of its sweeping nationalization program—with the job of getting what was then CII-Honeywell Bull (now just Bull) out of a hopeless-looking situation marked by massive operating losses and a highly heterogeneous and incompatible product line.

He locked his sights onto two basic strategies, one immediate and one long-term. First, he pared down the company's monolithic administrative apparatus and divided it into coherent profit centers based on the kind of equipment or service each was selling.

This has already paid dividends by dramatically cutting the firm's operating losses and putting it in a position where it could turn a profit as early as next year. That would be one year ahead of the scheduled financial-stability deadline agreed to with the government.

As a long-term strategy, Stern set out to realize a goal that, if it is successful, will not only strengthen Bull but will have a resounding impact on the data-processing industry in general. Stern's mission is, simply, to get European adoption of the open-systems interconnection standards now being defined by the International Organization for Standardization and the International Telegraph and Telephone Consultative Committee. He is convinced that this would be quickly followed by its adoption worldwide. The result would be, he asserts, a fundamental realignment of the data-processing industry where customers will be free to choose the most efficient supplier for their needs, rather than the safest.

Breaking IBM's hold. Stern sees this as the only way that Bull and other manufacturers of data-processing equipment can break the death grip of IBM Corp. on what he sees as its inordinate share of the world market. "We have a clear choice, and that is whether we want to determine the future of the computer business ourselves or whether we want IBM to determine it for us."

So far in his quest, Stern has been successful. With the support of Siemens AG, of Munich, and the UK's ICL plc, he was one of the driving forces behind the agreement of the 12 major European electronic data-processing-equipment manufacturers to conform to OSI standards [*Electronics,* March 22, 1984, p. 63]. But the main impetus, he thinks, will come from customers who will jump at the chance finally to be independent of any given EDP-equipment supplier.

Stern, 52, is a graduate of the prestigious École Polytechnique and holds an master's degree in computer science from Harvard University. Before joining Bull, he was president and chief executive officer of the Société d'Études des Systèmes d'Automation, a computer-networking and -automation systems company that he founded. **–Robert T. Gallagher**

Lane aims Visitronic at industrial targets

Littleton, Colo.

For more than a decade, distance-sensing circuits from Honeywell Inc. have helped camera buffs to get a clear picture of the world. This year, the firm's Visitronic operation in this Denver suburb is refocusing its efforts on emerging industrial and laboratory measurement markets. Heading up that new thrust is R.D. (Dick) Lane, Visitronic's director and a 22-year Honeywell veteran.

In 1977, Visitronic was formed in Denver to carry on the sensing-product and technology efforts of Honeywell's Photo Products Division, which had been sold off the year before. Now, Visitronic has shifted its sights to integrating low-cost light-sensing technology with a number of noncontact measurement applications. "We like to think of ourselves as a source of new, unique, low-cost, simple solutions that can be applied to a wide range of areas," says Lane.

The 44-year-old native of Minneapolis was named director of Visitronic in early 1983. Prior to that, Lane was involved in a number of

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µPD65010	1,300	µPD65060	6,500
µPD65020	2,100	µPD65080	8,000
µPD65021	2,100	µPD65100	11,000
TTL			
µPB6101	250	µPB6111	1,000
µPB6102	550	µPB6120	2,000
µPB6103	850		
ECL (100K)		ECL (10KH)	
µPB6301	300	µPB6311	1,200
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BRITTON LEE FORTIFIES POSITION IN DORMANT DATA-BASE MARKET

Los Gatos, Calif.

Though six years have passed since data-base machines began appearing, at least a few more years will go by before they will be widespread. Some analysts doubt that makers of data-base machines will ever have a heyday, but others in the industry, such as David Britton, president of Britton Lee Inc., interpret a number of signs as evidence that the market is coming together.

While awaiting the boom it expects, Britton's firm is living comfortably off the 350 intelligent data-base machines it has sold since 1981. Over the last 12 months, its sales have hit $16.5 million. "We're very profitable. We're among the best performers," Britton remarks.

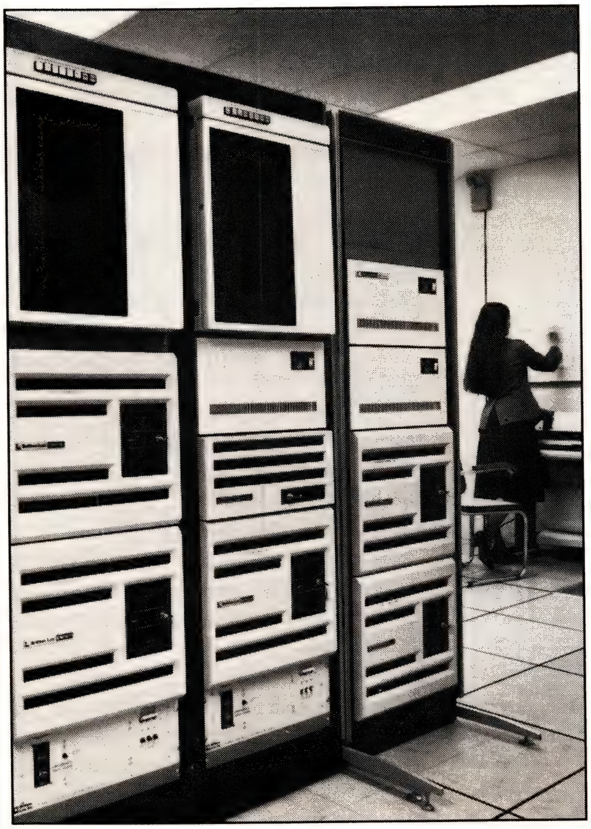
Britton Lee's fortunes recently climbed a couple of rungs when Mitsubishi Corp., Tokyo, purchased 200,000 shares of its stock for $2 million. Almost simultaneously, Britton Lee disclosed its plans to go public with an initial offering of 1.8 million shares of stock.

Analysts believe several things must be in place before the data-base machine can proliferate. "Its fortunes are tied to local-area networks," says Ann L. Morley, a market analyst with International Data Corp., Framingham, Mass.

To at least some extent, Britton agrees. "We need to break down barriers between vertical applications," such as data processing, manufacturing, and finance, he says. If all of a firm's data is handled by one system, a separate hardware and software system dedicated to filing, retrieving, and analyzing data can become an attractive alternative to host-resident software. With its own central processing unit, it doesn't have to compete with other packages running on a host, and it can take over the data-base burden.

Britton Lee's IDM line accommodates multiple mainframe, minicomputer, or microcomputer hosts. At the low end is the IDM-PC, which sells for about $60,000 in a configuration that handles 24 users. The IDM 500/1 supports up to 4,000 users on 64 hosts, with a capacity of over 10 gigabytes. Buyers are typically Fortune 500 companies and include AT&T (which has purchased 44 models), 3M, Motorola, the Boston Globe, and Digital Equipment.

Happy. "We're very profitable," says a confident David Britton, president of Britton Lee.



Optimistic. The market for data-base machines, such as Britton Lee's IDM line, is about to take off, maintains Britton Lee's president David Britton. The firm, which has sold some stock to Mitsubishi, plans to go public.

Big battle. Vendors such as Britton Lee are battling entrenched software data-base vendors, such as IBM Corp. and Cullinet Software Inc. [*ElectronicsWeek*, Nov. 12, 1984, p. 59]. Another task Britton Lee faces, analysts agree, is convincing people they can safely put all their eggs in one data-base machine. To Morley, it's "a pretty scary thing" for a company to purchase such a crucial component of data processing from a firm other than its main hardware or software supplier.

Another reason Britton Lee's IDM has not yet gained a stronger foothold is because it doesn't offer enough software to enable it to suit a variety of applications, analysts say. "Britton Lee meets price-performance requirements for a narrow segment of the market," states Curt Monash, a vice president with Paine Webber Mitchell Hutchins Inc., New York. Aware of the problem, Britton

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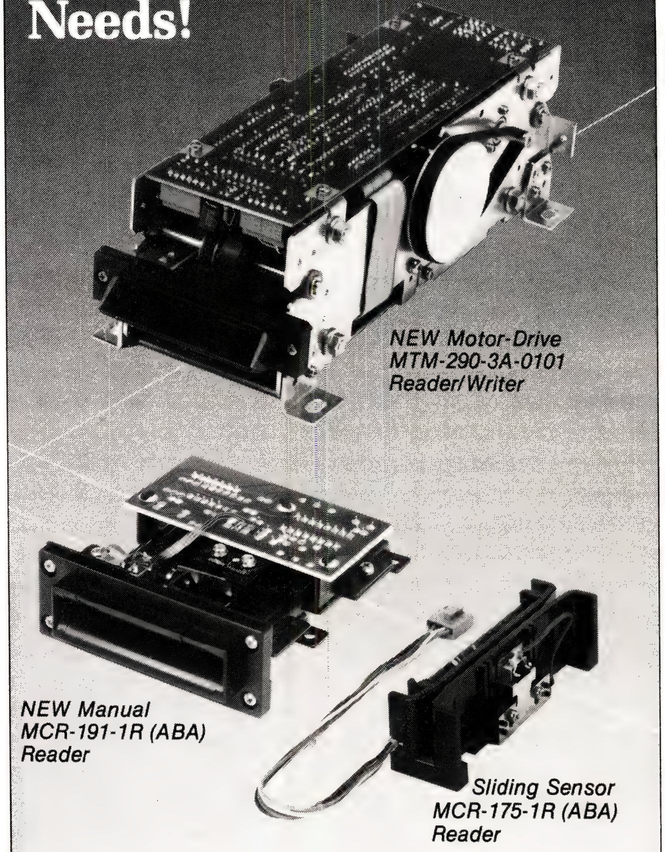

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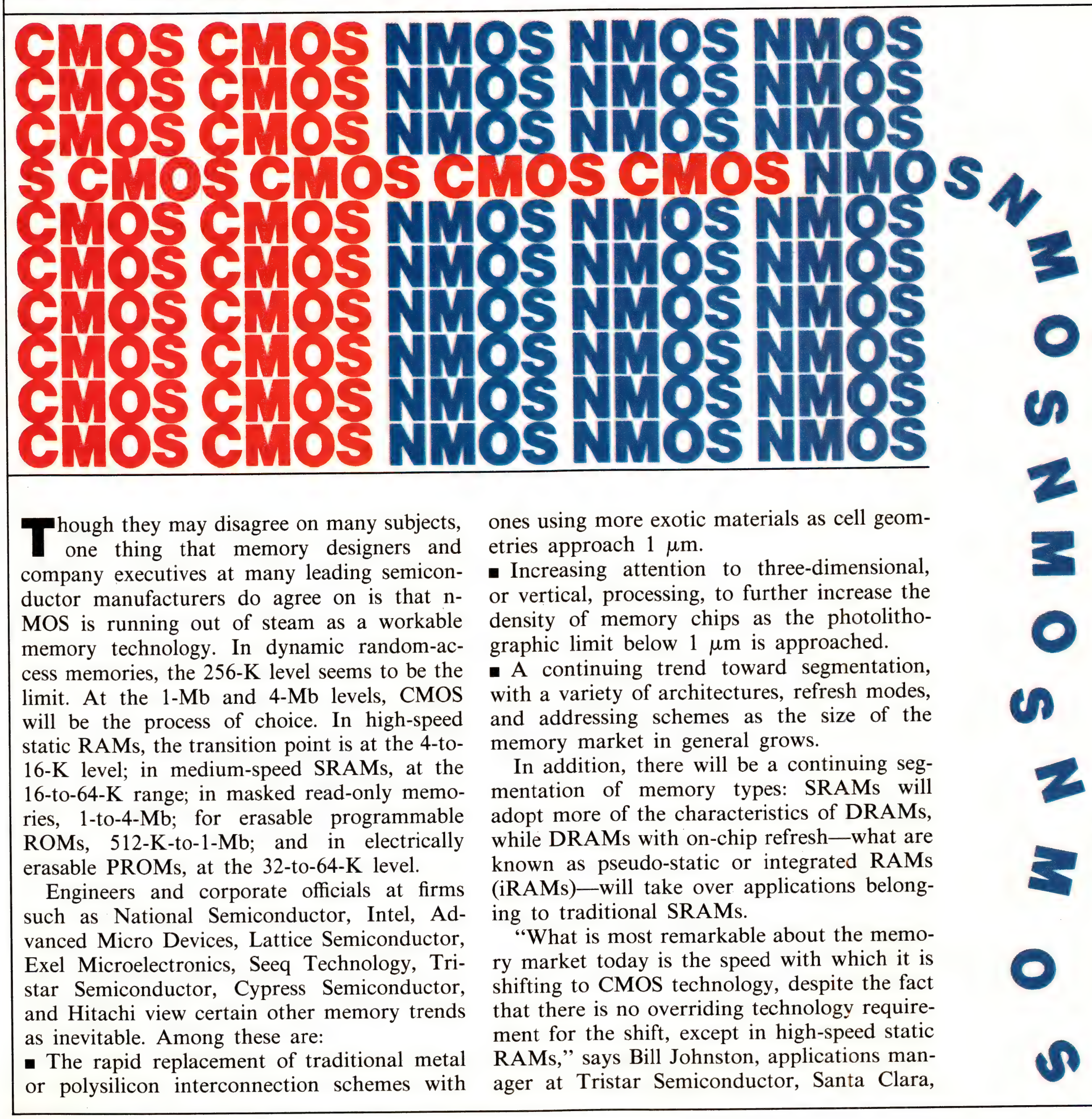
SPECIAL REPORTS

CMOS MEMORIES REPLACING n-MOS IN MEGABIT STORAGE CHIPS

Changes also expected in interconnection, processing, and architectures as cell sizes shrink

☐ *by Bernard Conrad Cole*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Though they may disagree on many subjects, one thing that memory designers and company executives at many leading semiconductor manufacturers do agree on is that n-MOS is running out of steam as a workable memory technology. In dynamic random-access memories, the 256-K level seems to be the limit. At the 1-Mb and 4-Mb levels, CMOS will be the process of choice. In high-speed static RAMs, the transition point is at the 4-to-16-K level; in medium-speed SRAMs, at the 16-to-64-K range; in masked read-only memories, 1-to-4-Mb; for erasable programmable ROMs, 512-K-to-1-Mb; and in electrically erasable PROMs, at the 32-to-64-K level.

Engineers and corporate officials at firms such as National Semiconductor, Intel, Advanced Micro Devices, Lattice Semiconductor, Exel Microelectronics, Seeq Technology, Tristar Semiconductor, Cypress Semiconductor, and Hitachi view certain other memory trends as inevitable. Among these are:

- The rapid replacement of traditional metal or polysilicon interconnection schemes with ones using more exotic materials as cell geometries approach 1 μm.
- Increasing attention to three-dimensional, or vertical, processing, to further increase the density of memory chips as the photolithographic limit below 1 μm is approached.
- A continuing trend toward segmentation, with a variety of architectures, refresh modes, and addressing schemes as the size of the memory market in general grows.

In addition, there will be a continuing segmentation of memory types: SRAMs will adopt more of the characteristics of DRAMs, while DRAMs with on-chip refresh—what are known as pseudo-static or integrated RAMs (iRAMs)—will take over applications belonging to traditional SRAMs.

"What is most remarkable about the memory market today is the speed with which it is shifting to CMOS technology, despite the fact that there is no overriding technology requirement for the shift, except in high-speed static RAMs," says Bill Johnston, applications manager at Tristar Semiconductor, Santa Clara, "However, if there is some sort of technological breakthrough, allowing development of a one-transistor erasable cell, a 1-Mb EEPROM is not unreasonable," says Young of Exel.

TABLE 1: CMOS MEMORY DENSITY TRENDS

Design rules Type of memory	1 μm	0.7 μm
6-transistor SRAMs	64 Kb (1984)	256 Kb (1986/1987)
4-transistor SRAMs	256 Kb (1986/1987)	1 Mb (1988/1989)
DRAMs	1 Mb (1985)	4 Mb (1988/1989)
EPROMs	2–4 Mb (1986)	8–16 Mb (1988)
EEPROMs	256 Kb-1 Mb (1987/1988)	1 Mb-4 Mb (1988/1990)
ROMs	1 Mb (1984)	4–16 Mb (1986/1987)

For greater densities, a shift to submicron design rules will be necessary. With 0.7-μm rules, says Pashley, 4-Mb DRAMs are achievable, as are six-transistor 256-K and 1-Mb SRAMs, 1- to 4-Mb EEPROMs and 8- to 16-Mb EPROMs. Many of the designers also agree that as circuit geometries approach the submicron range, the use of CMOS alone will not be enough. It will also be necessary, among other things, to increase cell capacitance and use more exotic interconnection materials.

"Such techniques, together with 0.5- to 1.0-μm design rules, will be enough to get us to about 4 Mb in DRAMs and perhaps 1 Mb in SRAMs, but beyond that we may have to start looking at three-dimensional design techniques," says Pashley.

As memory densities increase, alpha-particle radiation becomes increasingly significant, as it discharges the capacitors on storage cells and bit lines as well as on the sense nodes of the sense amplifiers. Thus it is necessary somehow to increase the storage cells' capacitance enough to offset that reduced by electron pairs generated by alpha particles.

Increasing stored charge

In 256-K n-MOS DRAMs and in CMOS memories beyond 1 Mb, most designers suggest that to increase the stored charge it will be necessary to use insulators with a dielectric constant higher than that of silicon dioxide. "Silicon nitride is generally accepted as the most viable alternative," says Grewall of National, which is employing this technique in its triple-polysilicon 256-K n-MOS DRAMs. "First of all, it stores about 50% more charge, and secondly, the nitride can be sandwiched between oxide layers. This makes it easier to incorporate into existing processes."

According to Pashley, however, such an alternative will be implemented industry-wide only when absolutely necessary, as it does require more complex processing. "Moreover, there are a number of questions as to its reliability and reproducibility compared to silicon dioxide," he says.

A better alternative, some designers suggest, is tantalum pentoxide, which is not significantly more complex than silicon nitride to process. But with five times SiO_2's permitivity, tantalum pentoxide offers much more payoff for the same amount of development effort.

"Fortunately, the stored-charge problem is less critical in CMOS memories, especially those which employ epitaxial layers to reduce silicon-controlled-rectifier latchup, a problem that is endemic to CMOS circuits," says Pashley.

"For the same die area, CMOS DRAMS have significantly more V_{CC}-to-V_{SS} capacitance than their n-MOS counterparts, due to the presence of the well-to-substrate capacitance." In addition to its uses as an antilatchup mechanism, the use of an epitaxial layer enhances this capacitance as the depth of the well approaches the thickness of the epitaxial layer. "At the normal supply voltage of 5 V," says Grewall, "the capacitance can as much as double."

At higher memory densities, as cell sizes get smaller and arrays much larger, interconnections occupy a greater percentage of the circuit. To reduce die size, a major effort is under way at most memory makers to make the lines narrower and thinner, as well as to stack more interconnection levels. "The problem is that as lines get thinner and longer, interconnection resistances increase and time delays stretch out," says Arun Kamat, product marketing manager for AMD's Advanced Technology Division, Sunnyvale, Calif.

For the bit lines, most designers expect aluminum to remain the material of choice, at least down to 1-μm geometries. Below that, copper and silicon doping of the aluminum will be necessary to mitigate migration and contact problems. Below 1 μm, tungsten is the material of choice. For word lines, the alternatives, says Intel's Pashley, are the traditional polysilicon refractories, silicides, or polysilicon silicide composites, called polycides.

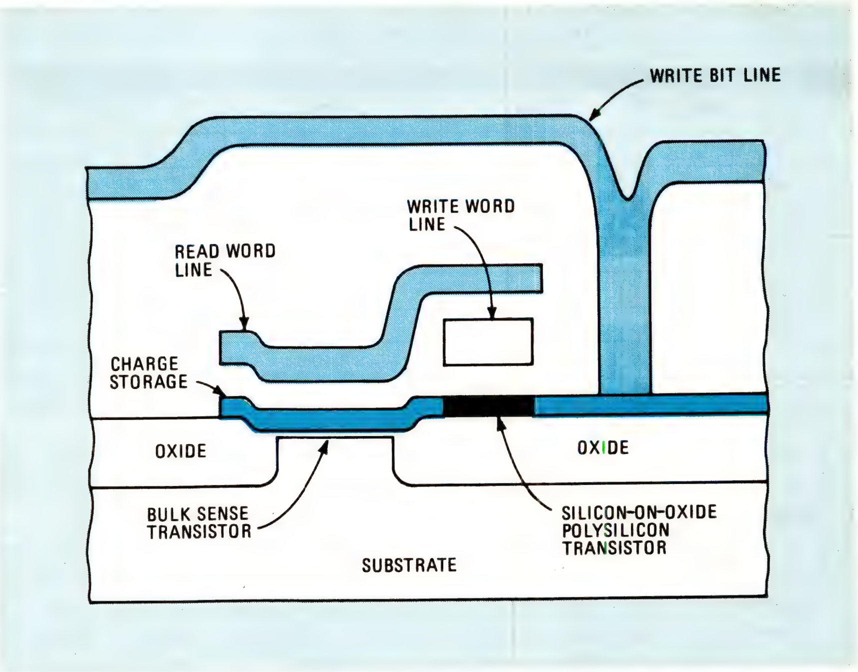
"At the 256-K level, polysilicon is largely ruled out because of the high sheet resistances involved," says Pashley. "Refractory metals would be ideal, with sheet resistances almost an order of magnitude lower than polysilicon, and will obviously be needed at the 4-Mb DRAM and 1-Mb SRAM levels. But a lot of work is needed on the deposition techniques involved."

Polycides or silicides necessary

Most 256-K DRAMS and 64-K SRAMs are being manufactured with word lines fabricated using polycides or silicides, with one eighth to one quarter the sheet resistance. At the 1-Mb level, virtually every memory manufacturer interviewed agreed that either polycides or silicides will be absolutely necessary.

"While the sheet resistance is not quite as low as refractory metal, the trade-off is in the fact that the processing is compatible with existing processes, which reduces the effect on cost and yield," says Pashley. He points out that the first step in forming a polycide is to deposit polysilicon.

As memory chips in general move beyond the megabit level, most designers reluctantly admit that it will be necessary to think about vertical processing by stacking tion to being perpendicular to a buried depletion-mode device, is also in the same well. This technique offers not only improved density but also a significant increase in the resistance to the degrading effects of alpha-particle bombardment. A second experimental approach stacks n- and p-channel devices one above the other, utilizing a single gate to provide control of both devices.



3. Silicon sandwiches. By using conventional bulk-silicon transistors as the foundation, and forming lower-performance transistors on top of them, researchers hope to increase the storage capacity of both DRAMS and SRAMS without increasing the silicon area required.

The hallmark of the DRAM marketplace as it enters the megabit range is segmentation and diversity: in markets, in process technologies, in architecture, in input/output alternatives, and in access modes. "There has always been this sort of diversity as memories moved to new density levels, but usually things sorted themselves out as one or two companies established market dominance and set *de facto* standards," says Johnston of Tristar.

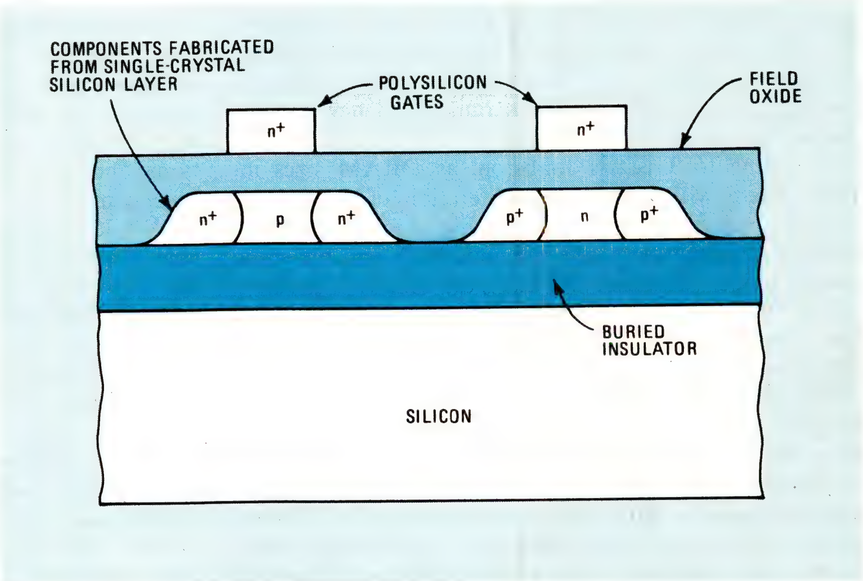
The current generation of n-MOS 64-K DRAMs is expected to peak in 1985, when the market value will approach $2.5 billion, according to Pat Brooks, DRAM marketing manager at Intel. Most observers forecast the peak for 256-K parts to occur around 1988, with peak-year revenues of about $5.6 billion. As production of 256-K DRAMS expands, most company executives expect it to drive continued growth in the entire DRAM market. By 1989, the entire DRAM market worldwide is expected to be $9.2 billion, compared with about $3.4 billion in 1984. Brooks says the market is expected to triple in the next five years, primarily because of 256-K DRAMs. As a result, DRAMs will actually increase their dominance of the worldwide market for MOS ICs (Table 2).

"Even though the cost of participation in the memory market is expected to grow anywhere from four to eight times as density increases, companies can still target very specific segments and make a substantial profit," says Bill DeMatteis, director of strategic marketing at AMD. "Just a 5% portion of the expected 256-K DRAM market in 1988, for example, would provide revenues of around $250 million to $275 million."

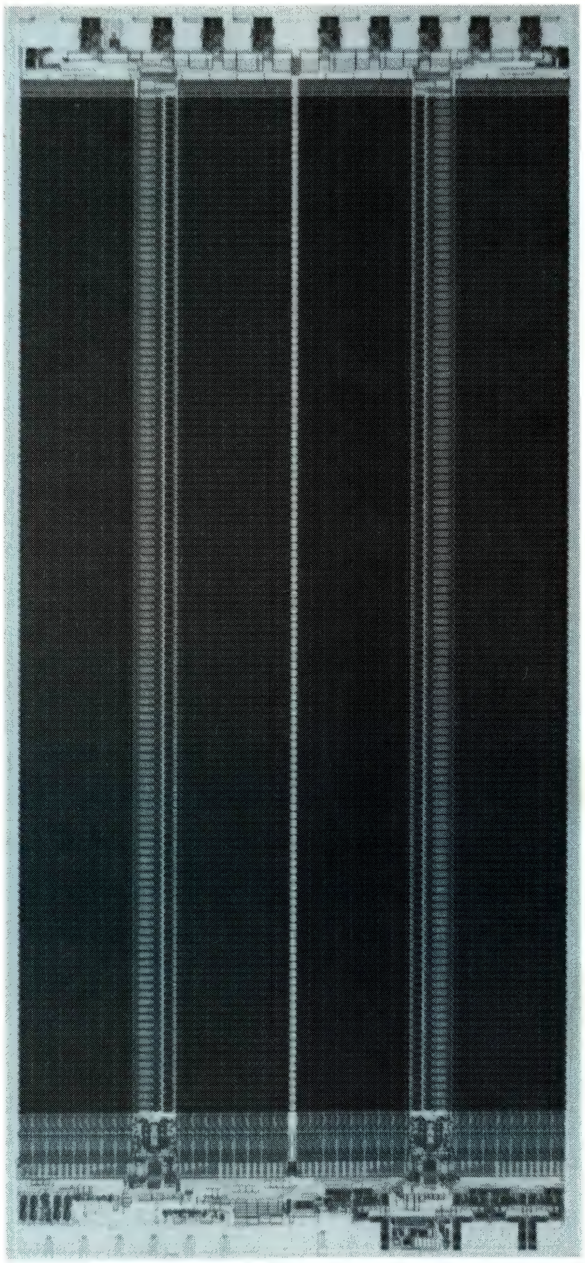
With these kinds of numbers, it is no longer necessary to go after a major portion of the pie. A small slice for most companies is more than adequate, says Young of Exel.

As a number of new categories of products based on memories has emerged, the nature of the market has changed. Among the new categories, says Brooks, are product types such as portable and personal computers, engineering and desktop work stations, computer-aided-design, -engineering, and -manufacturing systems, and specialized applications such as graphics and robotics. "With the emergence of megabit DRAMs, a whole range of artificial-intelligence applications opens up for personal computers," he says. "The main stumbling block to their implementation on small computer systems has been not so much the lack of capability of the CPU but the amount of memory available."

Megabit DRAMs will also increase the size limits of software programs available on personal computers. In-



4. Silicon on insulator. In order to reduce the space required by the dioxide insulation used between standard transistors on a chip, a buried insulating layer is placed between the bulk silicon and the active silicon from which the transistors are fabricated.



5. High-performance SRAMs. High-density CMOS static RAMs, which have densities as high as 64 kb and access times in the range of 35 to 50 ns, have been manufactured by Lattice Semiconductor, as exemplified in their SR64E4/SR64K4.

prove to be economical in microprocessor and microcontroller applications that do not require large amounts of memory—situations where external refresh circuitry is ponderous and not effectively amortized.

Many company executives interviewed believe the iRAM, which is essentially a DRAM with on-chip refresh logic, may break the domination of this portion of the market by the Japanese. Currently supplied only by Intel in an n-MOS 16-K-by-8-bit configuration, the iRAM has caught the eye of many companies, which prefer this alternative in CMOS because it pairs the advantages of the SRAM's easy system interface with the higher density and lower cost per bit of DRAMs.

Although complicated internally, the iRAM uses a simple external interface just slightly different from that of an SRAM, says Huffman. In many applications where slow SRAMs have traditionally been used, he says, the iRAM concept offers a lower-cost, higher-density alternative to the slow static RAM.

"Indeed, the iRAM concept seems to be coming to the forefront as a viable, cost-effective alternative to the use of both DRAMs and slow SRAMs in systems which have smaller RAM requirements," Turiff says. "Such a device also seems to be an attractive storage alternative in computer peripheral devices, telecommunications products, and office automation equipment."

EEPROMs lagging

Although introduced before EPROMs, EEPROMs lag behind by nearly two generations, having reached the 32-K and 64-K levels only within the last few months. The slow move toward higher densities is due to initial limitations placed on chip design by multiple power supplies and the size of the nitride oxide or floating-gate structures, as well as the high programming voltages required, says Bruce McCormick, Intel's programmable-memory marketing manager. In addition, EEPROM cells need at least two transistors and require two to five times more silicon than EPROM cells.

Despite this, he says, the EEPROM market is growing at a 70% to 75% annual rate. If the trend continues, total sales of EEPROMS are expected to climb from under $100 million in 1983 to over $1 billion in 1988. For this kind of growth, at least two things have to occur, says Michael Ares of Seeq Technology Inc., San Jose: standardization and higher density.

"One reason other memories have evolved and their markets have grown is that they are able to benefit from a standard 28-pin package," says McCormick. "By comparison, EEPROM manufacturers continue to use a variety of packaging schemes and pin configurations," he noted.

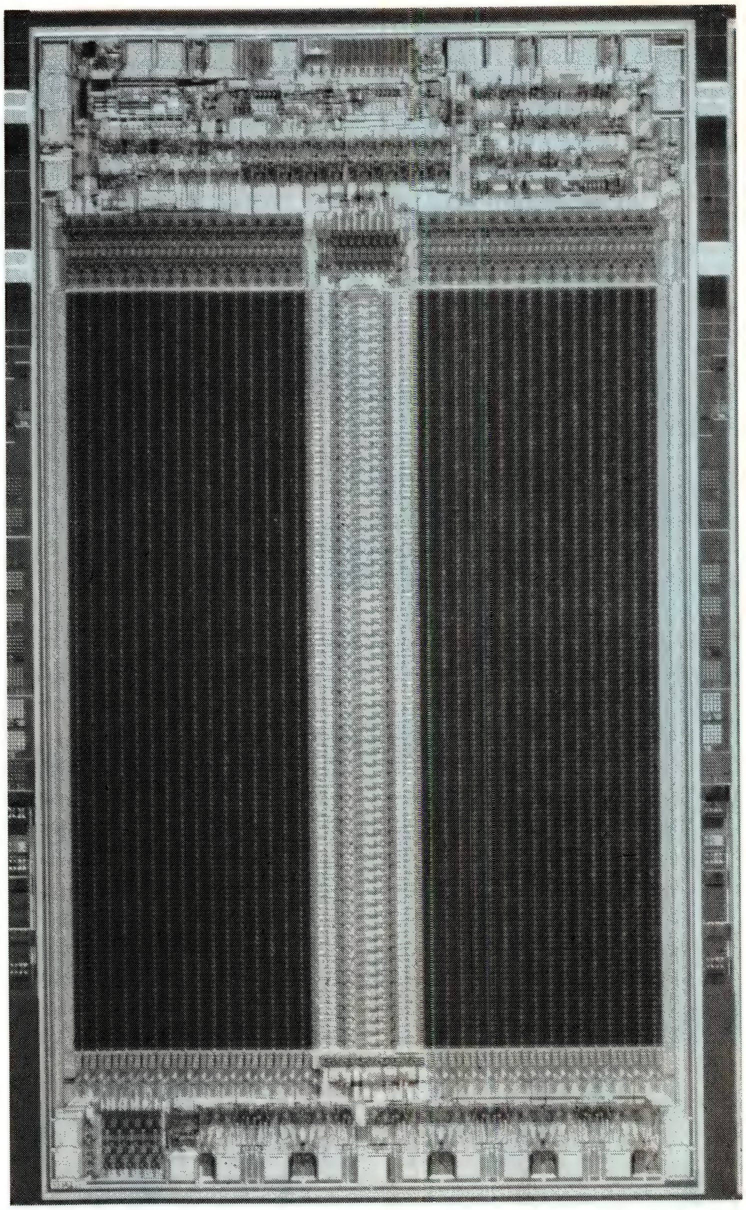
To increase density, most companies are looking for ways to scale the programming cell as well as various merged transistor structures. One promising approach, devised by Toshiba Corp., Kawasaki, Japan, involves the use of a dual-gate FET, where the address-selection transistor is eliminated from the individual cells.

Considerable work remains to be done, however, says Exel's Young. Until the problems of density and standardization are solved, most EEPROM manufacturers are focusing on three ways to spur market demand, and to expand the number and types of applications. One way is to reduce the read-access time of EEPROMs. By combining high-speed SRAM circuit techniques and CMOS technology, 32-K EEPROMs with access times in the 45-to-55-ns range are possible (Fig. 6).

According to Young, the best available MOS ROMs, EPROMs, and EEPROMs have access times around 150 ns or more, which limits them to relatively slow microprocessor applications or forces introduction of wait states into systems designed with high-speed microprocessors. "By reducing the access time to 45 to 55 ns, applications previously available only to fast SRAMs and bipolar PROMs open up, including high-speed control store in industrial and process control, graphics displays, and array-processor systems," he says.

A second trend is to design EEPROMs with more intelligence: on-chip features to simplify systems design

7. Smart and simple. On-chip features of this 150-ns, 64-K EEPROM by Exel are intended to simplify system design and reduce overhead. These include latches, timers, page-mode circuitry, and power-up, power-down, and power-noise protection.



split between the two process technologies.

"At 1 Mb and above, CMOS will be the only process used in EPROMs," predicts Young. Although not a primary objective for high-performance applications, he says, CMOS will substantially lower EPROM power dissipation, allowing such chips to be delivered in plastic packages without reliability problems, which is important if high-density OTPs are to become a reality.

ROM market trends

Despite increased competition in many markets from EPROM-based OTPs, the read-only market is still growing at a fairly respectable rate, from $625 million in 1984 to about $1.85 billion in 1989. Although at least half a dozen companies—Mostek, Motorola, and several Japanese firms—have introduced 1-Mb masked ROMs in both n-MOS and CMOS, with access times ranging from 150 to about 250 ns, the fastest-growing portion is in the lower-density 256-K, sub-100-ns range, where the aim is to simplify the interfacing to microprocessors by eliminating wait states and thus permit faster program execution.

Solid State Scientific Inc., Willow Grove, Pa., has just introduced a family of 75-ns 256-K CMOS ROMs. These, says Charles Hochstedler, director of product marketing, will open up a wide range of applications previously not open to this memory technology, including telecommunications systems, automobiles, and military electronics systems.

In telecommunications, such fast ROMs will allow manufacturers of mobile cellular radios to reduce radio size, weight, and power consumption, he says. The chips will also have a significant impact on new voice-and-data PBX switching systems, since manufacturers will now be able to put more operating features and speed into user sets while keeping system size small.

Automobile manufacturers can use these fast ROMs to get more capability and speed from a single microprocessor, says Hochstedler, all within the power consumption, physical size, and high temperature restraints imposed on circuits designed into automobiles. The combination of speed, density, and low power built into the new CMOS 256-K ROMs, he says, will also improve the performance of on-board military aircraft computers, and in missile targeting, navigation, and secure communications systems.

The erosion of the traditional applications for ROMs by less dense UV EPROM-based OTPs can be prevented only by a substantial increase in their density, says Exel's Young. "By this I mean not just 1-Mb or even 4-Mb devices, but by something approaching 8 to 16 Mb."

This is due to the fact that even one bit failure out of a million can render such a part useless. As a result, many manufacturers are considering building in 100% redundancy to handle all bit failures. "In other words, in order to get a 1-Mb ROM with no errors, you need a 2-Mb array," he says.

One alternative is to add electronic error-checking and correction circuitry directly onto the memory chip. However, this increases the chip size by almost 20% and increases access time by a similar percentage, he says.

A third technique is to combine ROM and EEPROM on the same chip. An example of this sort of approach is the Combined ROM and Electrically Erasable Memory (CREEM) chip from Motorola Inc., Schaumberg, Ill., in which the smaller EEPROM array acts like a reprogrammable page replacement to the larger ROM array. "Whatever the approach, something is necessary in order to prevent further erosion of the ROM market by other programmable alternatives," says Young. □

Bernard Conrad Cole is an editorial consultant and freelance technical writer in Berkeley, Calif.

ACOUSTIC MICROSCOPES SPOT IC FLAWS

Ultrasound from 10 MHz to 3 GHz checks out integrated circuits, chip capacitors, and hybrid assemblies

☐ *by Tom Adams*

Acoustic microscopes give makers of chip capacitors and hybrid microelectronic circuits the ability to test chips for internal defects—such as voids, cracks, and improper lead bonds—quickly and nondestructively. Their magnification capabilities, ranging from 7× to 400×, resemble those of more common light microscopes but offer the advantage of extreme sensitivity to internal discontinuities, both in light-transparent and light-opaque materials. Acoustic microscopes create images using ultrasound, a form of mechanical energy that is not a part of the electromagnetic spectrum.

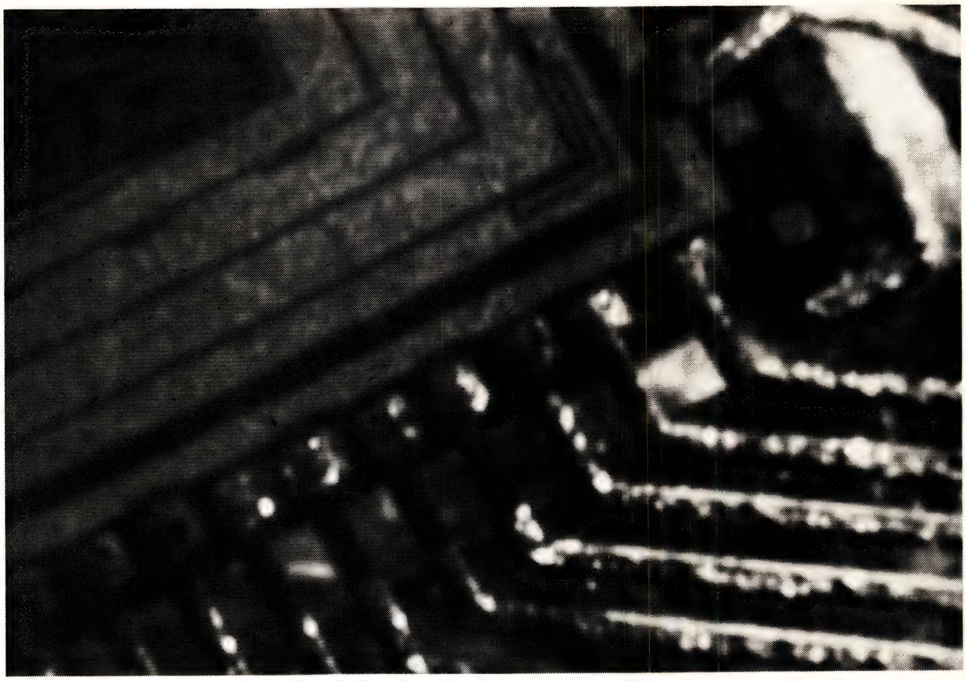
Images created by ultrasound used to be limited to cumbersome applications that provided very low resolution. The C-scan (see "Basic approaches to acoustic imaging," p. 64), hospital scanners, and naval sonar are among the examples of such early ultrasound applications. In recent years, advances in the supporting technology such as lasers and signal-processing chips have led to a more sophisticated class of instruments—the acoustic microscope.

Although acoustic microscopes can image a wide range of materials, their applications mostly involve microelectronic components, where the need for integrity of materials is acute. Within these materials, the technique reveals such discontinuities as intended interfaces, as well as material imperfections such as cracks, delamination, or foreign matter accumulations. Acoustic microscopes generally use ultrasound ranging from 10 MHz to 3 GHz, although no single microscope covers the entire range. The lower frequencies can penetrate relatively thick materials; under ideal circumstances, 10-MHz ultrasound will penetrate 6 in. of aluminum and produce an image. At the other end of the scale, 1-GHz ultrasound will penetrate only 25 μm or so of the same material.

Better resolution

The higher frequencies provide better resolution, however. At the highest ones, acoustic microscopes can in theory provide better resolution than light microscopes. The problem is that relatively few 25-μm-thick materials need inspection, though the surface and near-surface features of silicon chips have attracted some interest. The

1. Looking within. Inside a scanning-laser acoustic microscope (SLAM) is an ultrasonic transducer producing uniform plane waves beamed through the sample under test. Distortion of the ultrasound waves produces an acoustic picture of the sample's interior.



2. Spotting defects. A transmission acoustic micrograph of the bonded leads on the hybrid microcircuit's surface reveals that most of the lead bonds are dark, meaning that they contain delaminations. The lighter lead bonds indicate a good bond.

lower frequencies, which provide lower resolution but far more penetration, have the advantage of yielding quick and accurate information about a sample's internal structure.

The application possibilities inspired researchers to develop two kinds of acoustic microscopes, generally known as SLAMs and SAMs. The SLAM—scanning-laser acoustic microscope—operates over the frequency range of 10 to 500 MHz, the low and middle portions of acoustic frequencies. Made by Sonoscan, Bensenville, Ill., it is the only acoustic microscope that has enjoyed commercial success.

SAMs—scanning acoustic microscopes, produced by Olympus Corp., New Hyde Park, N.Y.; Leitz Inc., Rockleigh, N.J.; and Honda Co., Toyoshi, Japan—usually operate at higher frequencies, up to 3 GHz, for improved resolution. Although SAM appplications are now more limited, they are gaining acceptance fairly rapidly. The difference between a SAM and a SLAM involves more than just a laser. A SLAM is a through-transmission instrument that can image fairly large specimens. SAMs are reflection instruments and penetrate much less deeply.

A SLAM is a fairly large piece of equipment (Fig. 1). Recessed into its stage is an ultrasonic transducer, which produces uniform plane waves. Ultrasound generated by it is beamed upward through the sample on stage.

Because air does not transmit ultrasound, SLAMs and all other acoustic microscopes use water or some other fluid as a coupling agent for transmission. First, a few drops are placed on the transducer. The sample is put in place with a few drops of water on top of it. Over this goes a special cover slip—a rectangle of optically transparent plastic with a thin mirror of gold on its bottom.

As the ultrasound is beamed upward, it is differentially attenuated while passing though the sample. Some regions of the sample transmit much of the ultrasound, others less; still other regions—those with air gaps, for example—transmit none at all.

When the ultrasound reaches the cover slip's mirror surface, pressure slightly distorts the surface. The intensity of the arriving ultrasound determines the degree of that distortion, so that, in effect, the gold layer has an acoustic picture of the sample's interior.

The next step in the process is to detect this picture. Aimed from above, a scanning helium-neon laser scans a rectangular area of the gold layer 30 times per second. When the laser is reflected, the slope of the distortion changes its spatial-reflection angle minutely. A photodiode converts the laser's intensity into 1.2 million signals per second. With further processing, the electrical signals produce a visible acoustic image on a cathode-ray tube.

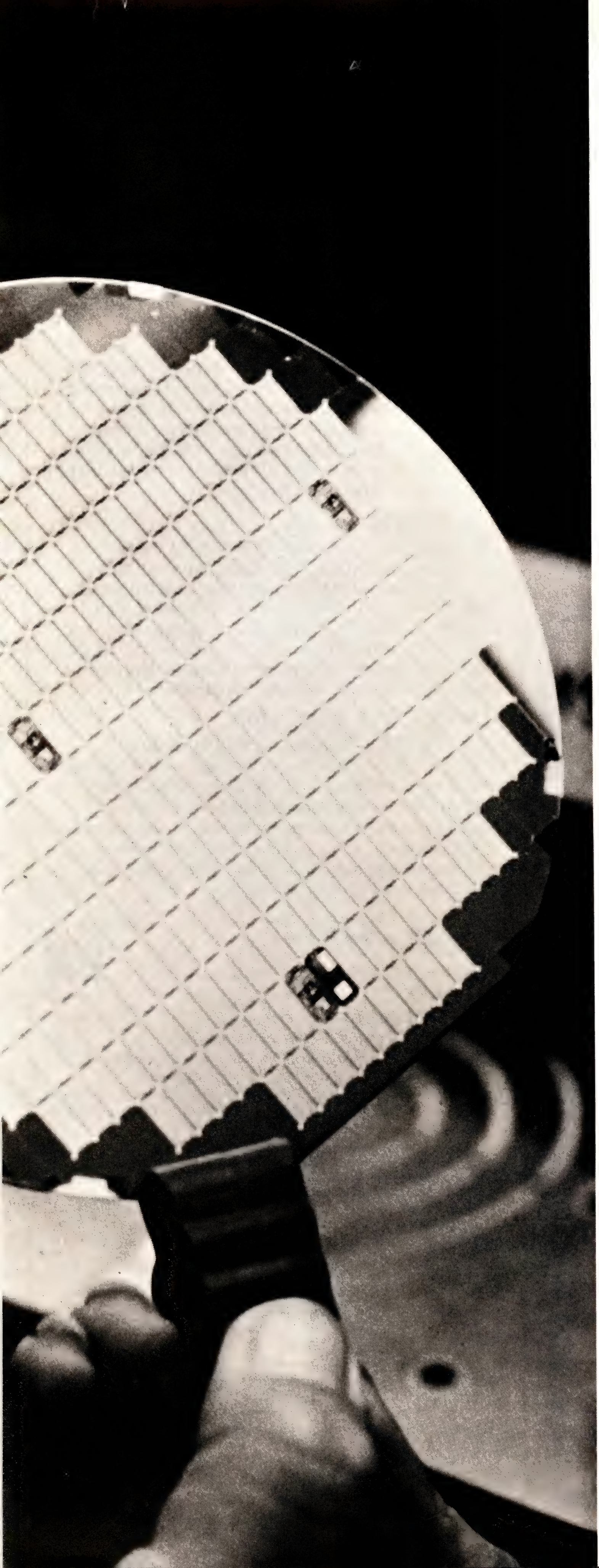
The acoustic images that appear on the SLAM's CRT are real-time, magnified, acoustic views of the sample's internal features. This type of image meets the needs of electronics-component and microelectronics manufacturers concerned about the integrity of integrated circuits, capacitors, and other hybrid components. The samples to be tested need no special preparation for imaging, and an image can typically be obtained in a minute or less.

Revealing flaws

In sheer numbers, ceramic chip capacitors are currently the SLAM's most important application. Several manufacturers have purchased SLAMs to image capacitors, and Sonoscan has established a discrete-capacitor-testing service. The SLAM can even image terminated and encapsulated capacitors.

Because ceramic capacitors have a multilayer construction, they are susceptible to internal delamination and to other internal defects—voids and cracks, for example. Such flaws escape visual detection. More important, capacitors afflicted with them can pass burn-in and electrical tests, which may not be severe enough to cause immediate failure. Eventually, thermal stress makes the capacitors break down.

SLAMs are also being used extensively in tape automated bonding, a technique that may replace traditional wire-bonders in many applications. In TAB, a continuous tape holds leads in position, and they are bonded simultaneously to the chip. Every lead has an inner and outer lead bond, each representing a location that should have no internal interface. Lead bonds are difficult to inspect, especially on high-density chips, which may have more than 200 leads. By using a SLAM to image the bonds, unintended gaps between the lead and the bond pad, or



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Indexer has its own 8085 processor to unload a host of tasks such as controlling velocity, acceleration, and distance traveled

☐ *by Steve Zollo*

Capitalizing on the growing use of IBM Corp. Personal Computers on the factory floor, Compumotor Corp. is introducing a complete motion controller that plugs into the PC. The PC21 Motor Controller is designed to control a single motor by issuing motion-directing pulses.

The PC21 indexer allows direct control of Compumotor's line of microstepping motors and drivers and may also be used to operate dc servo amplifiers with full closed-loop control. According to Joseph Pavlat, advanced development manager for the company, the PC21 indexer fits with the company's philosophy of making motion control a computer peripheral.

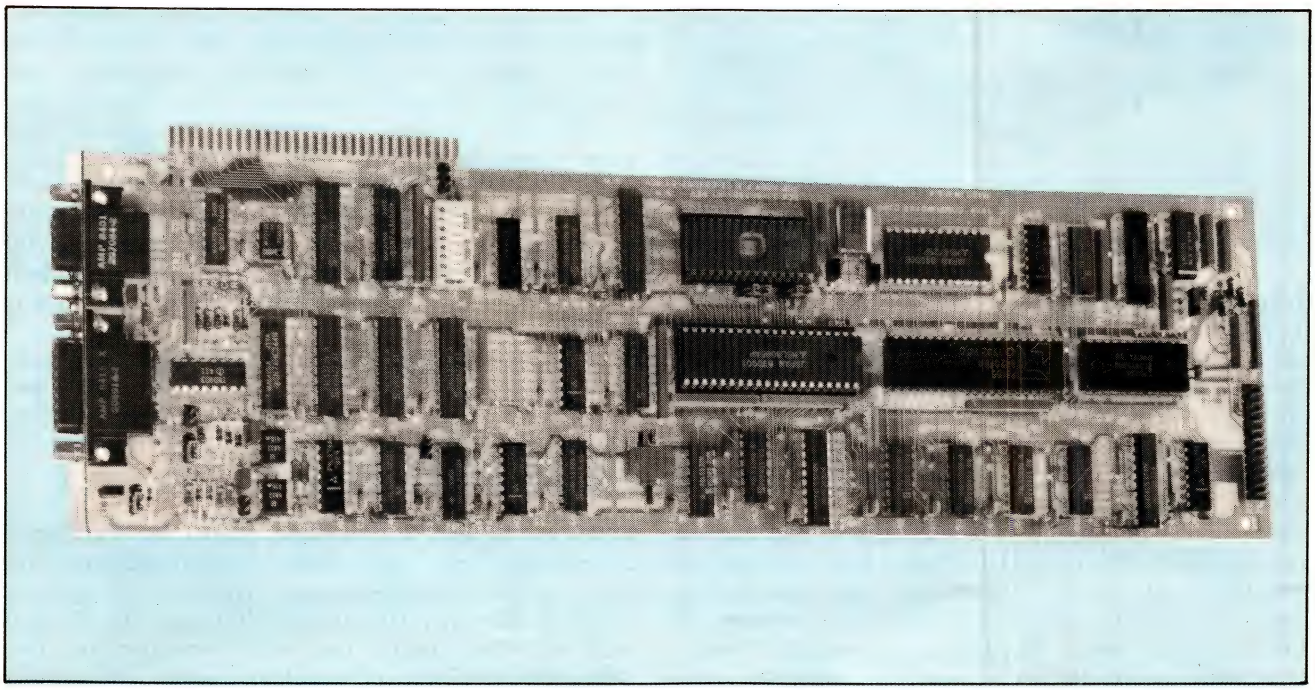
Thanks to an on-board 8085 microprocessor, the PC21 unburdens the PC's microprocessor from a substantial load. The indexer relieves the host of the tasks of controlling velocity, distance, and linear-acceleration parameters as well as monitoring end-of-travel limit switches.

All velocity, acceleration, and distance parameters are given to the motor controller in ASCII characters representing the number of pulses per second, per second^2, and the like. This allows the PC21 to control motors of virtually any resolution.

The indexer accepts high-level commands from the PC at its own address on the PC bus, so the engineer can use multiple indexer cards in the PC or in an expansion chassis. Simple motion commands will speed up or slow down the motor and driver, and simultaneously maintain positive control over distance.

A list of up to 300 commands may be assembled and stored in the PC21 indexer. The commands may later be executed in response to a command from the PC or an external signal. With the external triggering capability, complex sequences of moves can be executed while the PC attends to supervisory tasks.

The indexer supports motor positioning in absolute or



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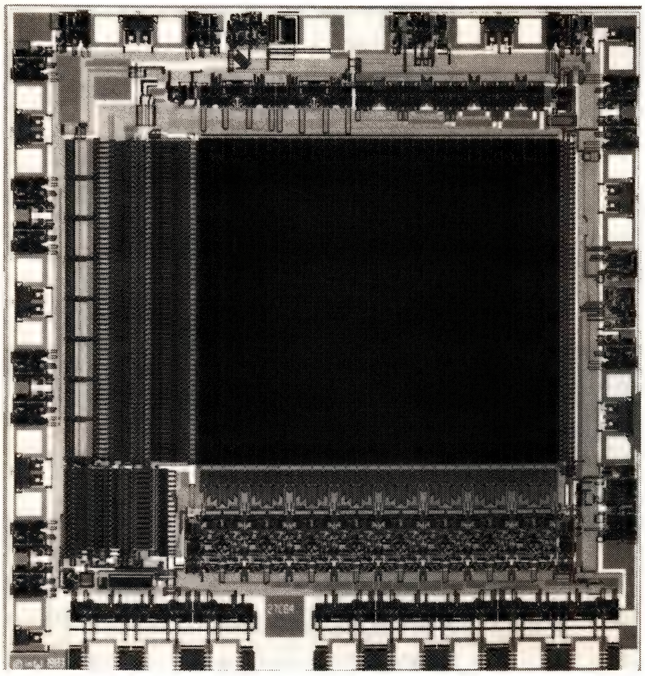
Exel Microelectronics Inc., 2150 Commerce Dr., San Jose, Calif. 95131. Phone (408) 942-0500 [Circle 345]

64-K EPROM bows in CHMOS II-E process



The 27C64 64-K erasable programmable read-only memory is Intel's first EPROM based on its high-performance CMOS II-E process. The company claims that the CHMOS technology combines the performance of HMOS and the low-power chracteristics of CMOS to give designers semiconductors that offer superior performance, high densities, and low power requirements. Moreover, CHMOS II-E uses unique epitaxial processing for maximum protection against latch-up problems commonly associated with traditional CMOS technology.

With an access speed of 200 ns, the 27C64 is well suited for lower-powered equipment such as transportable computers, communications equipment, and remote data-acquisition instruments. Programming support for the EPROM is the same as for Intel's 2764A HMOS EPROM. The part sells for $25.60 in lots of 10,000. Other speeds are available.

Intel Corp., Literature Dept., W-42, 3065 Bowers Ave., Santa Clara, Calif. 95051 [Circle 346]

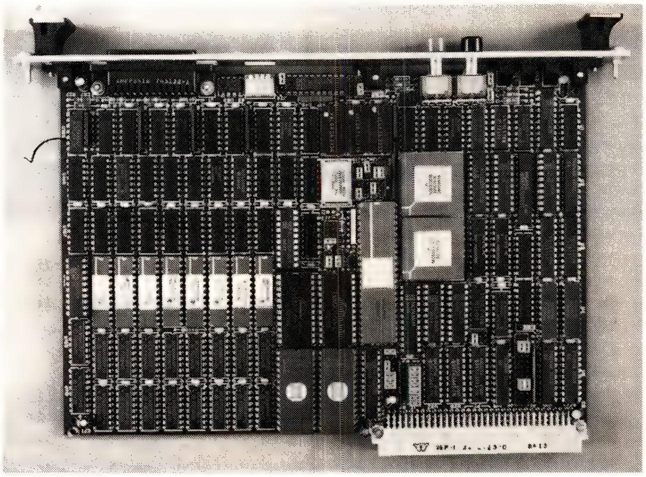
VMEbus board and controller perform image processing

A high-performance VMEbus-compatible microprocessor board and a companion system-controller module and input/output transition board are designed for high-speed image-processing, communications, and industrial-control applications. The MC68010-based microprocessor board provides a 4-K-byte cache memory, dual-port dynamic random-access memory, and the enhanced 68010 instruction set.

Designed for multiprocessor applications, the MVME120 board comes with either 128-K bytes or 512-K bytes of memory. The combination of the 68010, the 68451 memory-management unit, and the 4-K-byte no-wait-state instruction cache allows the user to implement virtual machine, virtual I/O, and virtual memory.

The companion module, the MVME050, provides system control, system utility, and debug and diagnostic functions. It implements system functions, such as bus arbitration, bus timeout, system clock generation, and time-of-day clock, that are required only once in a multiprocessing system.

A companion to the system-controller board, the I/O transition module (MVME701) is an optional Eurocard-format double-high board. It provides industry-standard parallel I/O ports along with optional batteries for backup or the time-of-day clock.



The MVME120 board runs under the VersaDos real-time operating system, Release 4.4, to be available in the first quarter of 1985. With 128-K bytes of memory, the MVME120 board sells for $2,575; the MVME121, with 512-K bytes, goes for $4,185. The system-controller module is $1,595, and the I/O transition board is $215. All are available now.

Motorola Semiconductor Products Inc., P.O. Box 20912, Phoenix, Ariz. 85036. Phone (602) 438-3501 [Circle 348]

I/O device lets processor get data without using host

A peripheral input/output device for the Mini-MAP array processor, the IOM-1 provides the means to transfer data to and from the Mini-MAP without passing through the host computer. The IOM-1, which consists of a DEC-style hex-size board, provides data-transfer rates up to 16 megabytes/s while linking peripherals directly to the Mini-MAP for high-performance real-time systems.

The IOM-1 is a basic digital interface to the Minition and the printing of graphic images by allowing users to take advantage of any added memory on their systems, the board also includes the company's SuperDrive random-access-memory disk simulator and SuperSpool print spooler utilities at no additional charge. Shipments of Preview! begin this month.

AST Reasearch Inc., 2121 Alton Ave., Irvine, Calif. 92714.
Phone (714) 863-1333 [Circle 350]

Card adds four serial ports for STD-based computers

Using two WD2123 Deuce serial input/output integrated circuits, the SI/O-4 provides four fully configurable RS-232-C serial communications channels on a single STD bus board. The baud-rate frequency for each channel can be internally selected through software, or it can be clocked through an external communications line.

The on-board clock generators may also be used to clock external devices. The board's four channels may operate individually at baud rates up to 19.2 kb/s.

The board has a diagnostic local loop-back mode and double buffering of data. In addition, the SI/O-4 uses a 60-pin header connector to provide high-reliability mass-terminated connection to four standard DB25-type RS-232-C connectors. Available 30 days after ordering, the boards are priced at $285 apiece.

Computer Dynamics Inc., 105 S. Main St., Greer, S.C. 29651.
Phone (803) 877-7471 [Circle 351]

$395 function generator reaches 2.1 MHz in 7 ranges

With a frequency span of 0.002 Hz to 2.1 MHz in seven overlapping ranges, the model 20 function generator uses an external transformer-battery charger to operate directly from the line. In addition, it can operate internally from nickel cadmium batteries.

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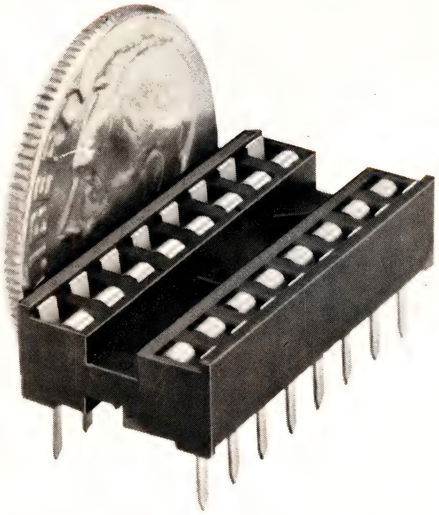

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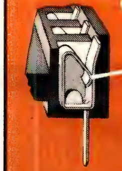

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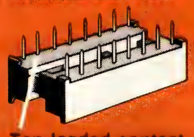

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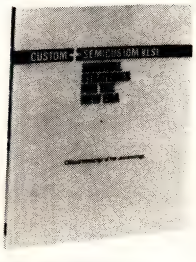

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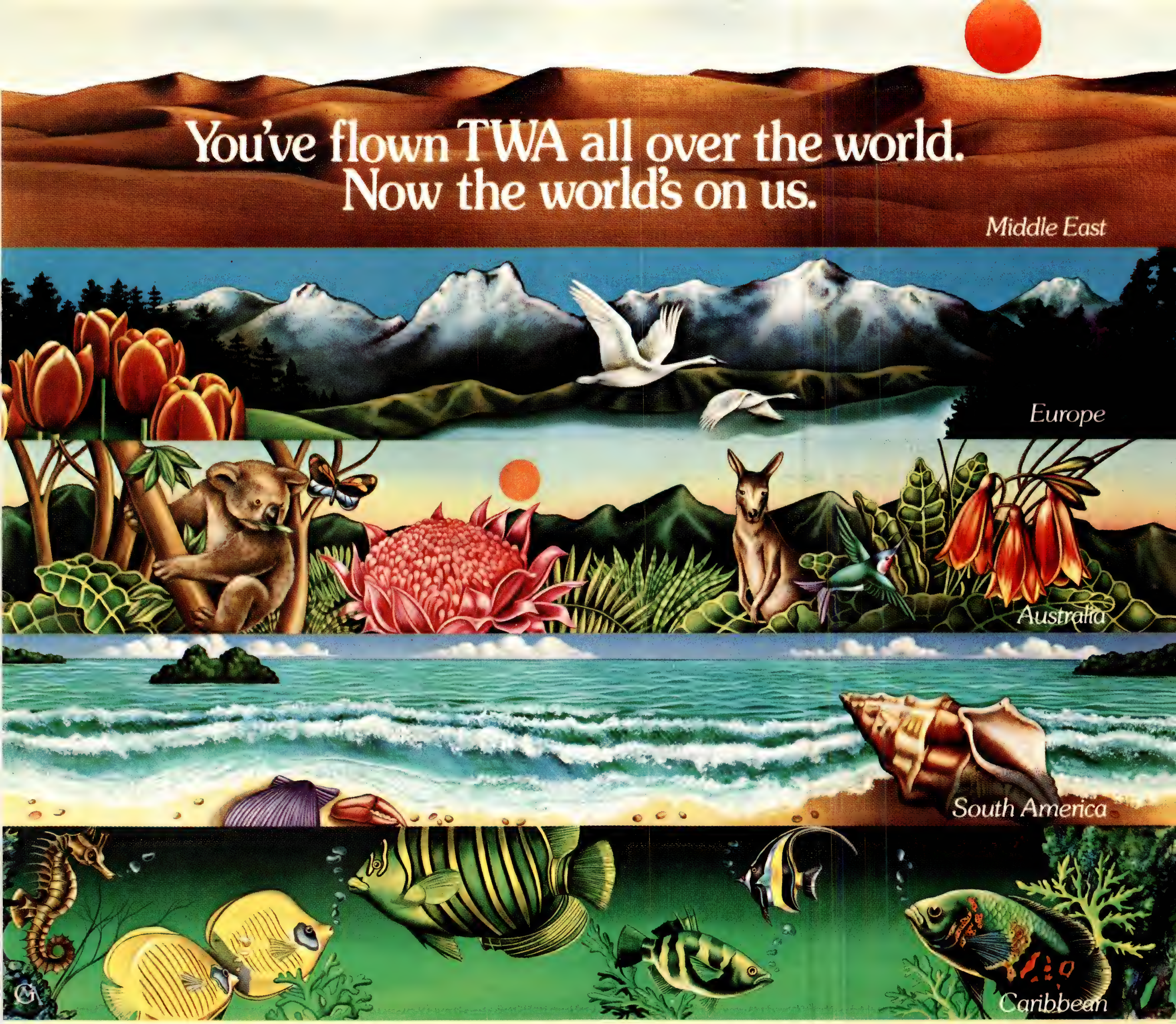

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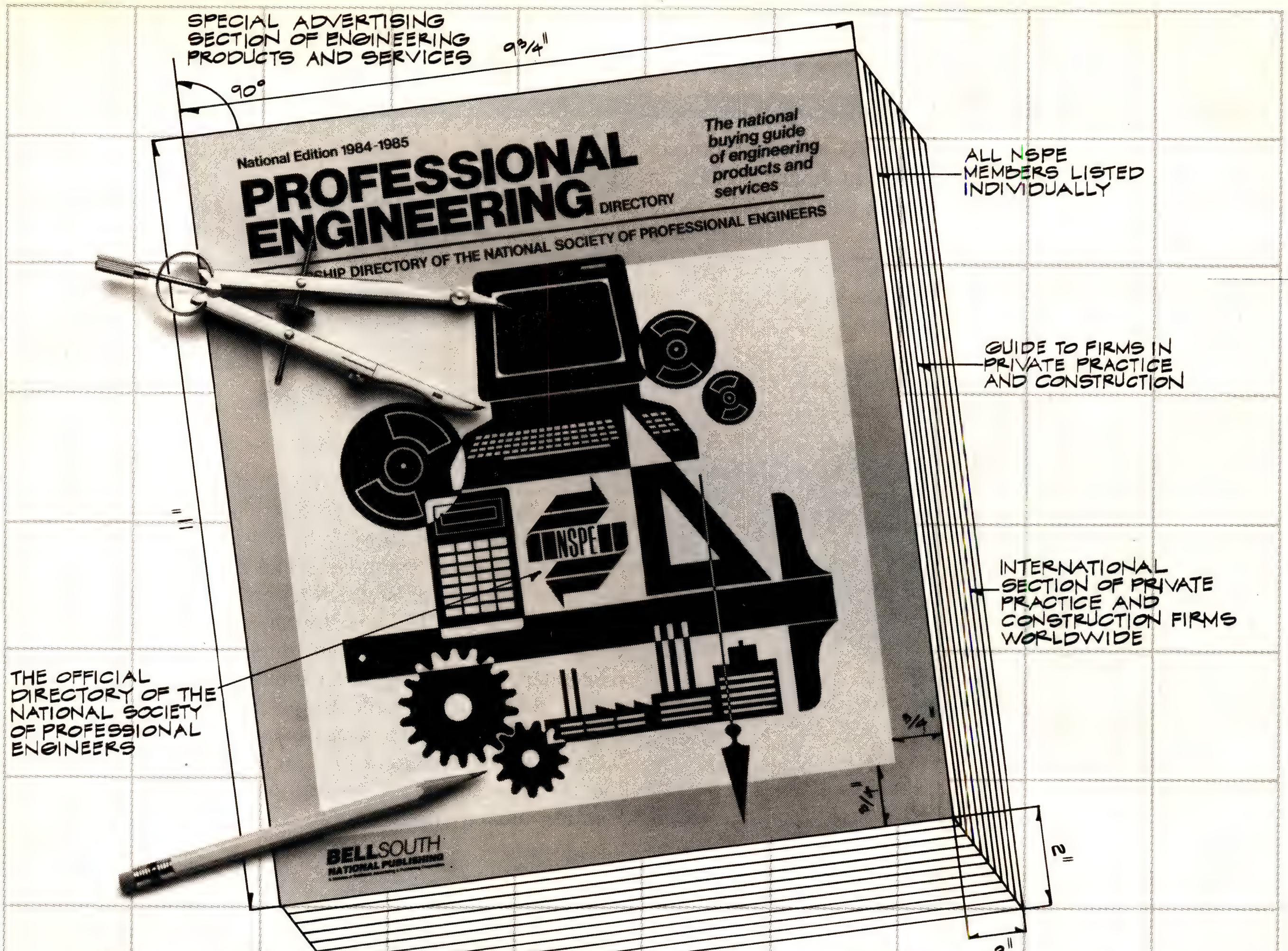
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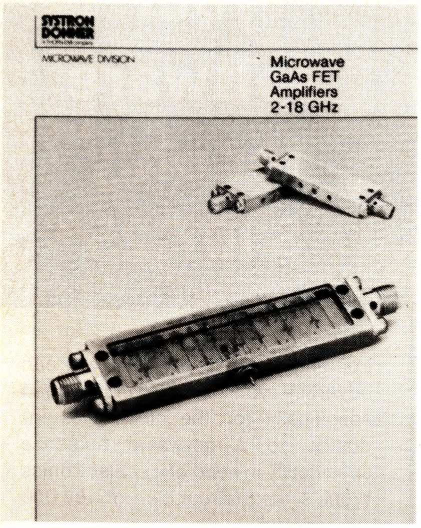

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Not limited to lenses. Edmund Scientific Co. has expanded its 1984-85 catalog for industry and education from 50 pages of its traditional optical offerings to include three pages of lasers (featuring Spectra Physics and Aerotech lasers) and three pages of fiber optics. Specifications, diagrams, and explanatory notes accompany each optics category. To request the catalog, call the manufacturer at (609) 547-3488, or write to 101 E. Gloucester Pike, Barrington, N.J. 08007. [Circle 422]

Look them up. Three bibliographies—"Videotex (vol. 1, 1979-1982)," "Robotics (vol. 1, 1980-March 1983)"—and "Universal Product Code (vol. 1, 1973-1982)," have been published by the Technical and Education Center of the Graphic Arts, Rochester Institute of Technology. These contain abstracts organized within the field by topic, and reprints of most articles abstracted can be ordered. Each bibliography sells for $15. Mail orders should be sent to T&E Center Order Department, Rochester Institute of Technology, 1 Lomb Memorial Dr., P.O. Box 9887, Rochester, N.Y. 14623, or call (716) 475-2739. [Circle 429]

Standard issue. Deutsche Industrie Normenausschus, the German Standards Institute, located in Berlin, has released its 1984 catalogs through a U.S. agent. In German industry, over 36,000 DIN standards apply to more than 600 fields, including the electrical and electronics industries. The "English Translations of German Standards Catalog 1984" lists over 3,500 items, all indexed. This catalog is available for $16 from Heyden & Son, 247 S. 41st St., Philadelphia, Pa. 19104. Phone (215) 382-6673. [Circle 425]

Face up to it. Specifications, descriptions, and applications with diagrams appear in this brochure on fiber-optic coupler-monitors, multiplexers-demultiplexers, and other fiber-optic interfaces and components. Copies are free from Kaptron Inc., 3460 W. Bayshore Rd., Palo Alto, Calif. 94303; place requests by telephone at (415) 493-8008. [Circle 427]

Superminicomputer survey. The 3210 superminicomputer's specifications are set forth in a six-page pamphlet that gives its history, surveys the systems, and lists options for this 32-bit computing system. Reliability and maintainability are also detailed. Copies are available at no charge from Perkin-Elmer Data Systems Group, 2 Crescent Pl., Oceanport, N.J. 07757. Phone (201) 870-4712 or (800) 631-2154. [Circle 423]

Patches aplenty. A 49-page catalog that covers patch panels, cords, cable assemblies, jacks, adapters, power assemblies, and more is offered to systems integrators. Many items meet military specifications, and the catalog opens with an eight-page application note. The catalog includes an index. This publication is offered by Trompeter Electronics Inc., 8936 Comanche Ave., Chatsworth, Calif. 91311, or call the company at (818) 882-1020. [Circle 424]

Make waves. Nine low-, medium-, and high-frequency oscilloscopes are featured in a brochure that describes such capabilities as alternate triggering, variable hold-off, and dual time-base operation. It includes information on the company's newest product releases, models LBO-516 (50 MHz, 2 channels) and LBO-525L (100 MHz, 3 channels). For a free copy, write to Leader Instruments Corp., 380 Oser Ave., Hauppauge, N.Y. 11788, or call (800) 645-5104 (in New York state, [516] 231-6900). [Circle 428]

Hybrid vigor. Six pages in color describe this manufacturer's capabilities for designing and building high-frequency hybrid-circuit packages. These include both thin- and thick-film techniques. Photos and descriptions of typical custom hybrid packages are included in the brochure. To receive a copy, contact EMC Technology Inc., 1971 Old Cuthbert Rd., Cherry Hill, N.J. 08034, or call (609) 429-7800. [Circle 430]

Shock waves. A four-page brochure covers the manufacturer's line of underwater and free-field blast-wave sensors, a tourmaline shock-wave transducer with a rise time of 0.1 µs, and other products. The sensors are offered in both charge-mode and voltage-mode configurations. Call PCB Piezotronics Inc. at (716) 684-0001 for a free copy, or write to the company at 3425 Walden Ave., Depew, N.Y. 14043. [Circle 426]

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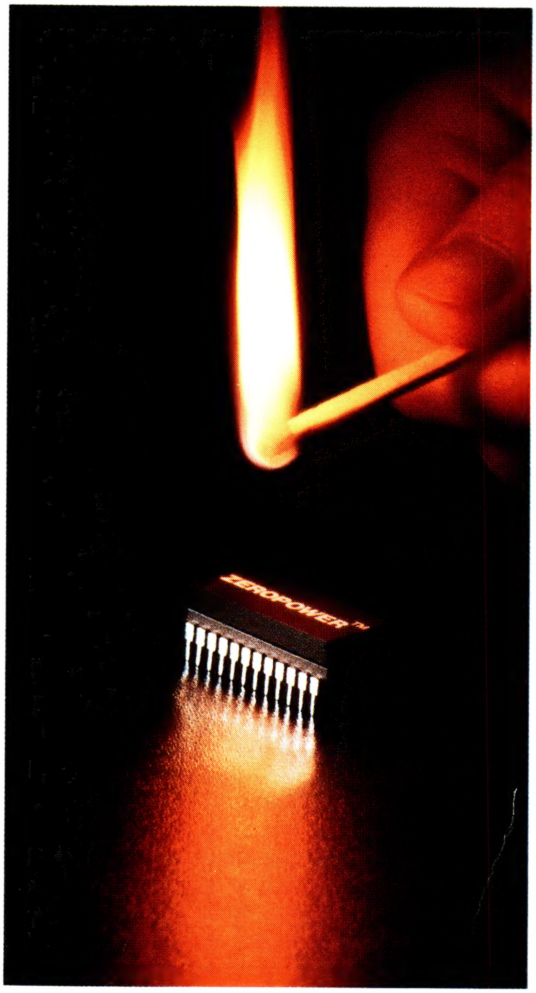

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